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THE INTERDEPENDENCE OF UROLOGY AND ROENTGENOLOGY*

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YOUR president has done me the honor to ask me to present a paper on the relationship between our two specialties and it gives me the greatest pleasure to appear before you.

There are no two branches of medicine which are more closely associated and more dependent upon each other than urology and roentgenology. Urology, like roentgenology, owes much to the remarkable advances which have been made in electricity. The cystoscope which closely followed the introduction of the incandescent light by Edison was the first great step in the development of urology, but the roentgen ray coming a few years later contributed largely to making urology one of the most accurate and interesting branches of medicine. In the old days our conjoint work was done with great difficulty. In order to secure roentgenograms of kidneys, exposures of fifteen or twenty minutes were necessary, and unfortunately roentgen-ray burns of fearful intensity occasionally occurred. There were no facilities for rapid work on the part of either specialist.

When called upon to design the Brady Urological Institute we endeavored first of all to provide proper organization and equipment for combined roentgenology and urology. Two adjacent rooms were connected up with a roentgen-ray apparatus, and a table was designed which was not only well adapted for urological studies but also carried an adequate roentgen-ray mechanism. In the first table[1] we did away with the break in the back which was covered with an aluminum top and carried a plate holder beneath. Parallel bars to carry the roentgen-ray tube stand were attached to the table, the top of which was given great mobility by means of a sector and worm mechanism so that roentgenograms could be taken horizontally, vertically or markedly depressed. This combined roentgenologic and cystoscopic table transformed and greatly simplified the work of both urologist and roentgenologist. With the advent of the Bucky-Potter diaphragm this was added to the table giving roentgenograms of greater detail, but owing to the special construction of the curved draphragm, stereoscopic pictures could not be taken except with difficulty and then were not in proper position for vertical observation afterwards.

A third table[2] was then constructed, the model of which I have the pleasure of showing you here. This has been made for me by the Max Wocher and Liebel-Flarsheim Companies of Cincinnati, Ohio. In

[1] Young, H. H. A urological examining and operating table. Modern Hosp., St. Louis, 1916, vi, 457.

[2] Young, H. H. An improved operating table, for general surgery, providing new features for urologic and gynaecologic work. Ann. Surg., 1925, lxxi, 566–572.

* Read at the Sixth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 22–24, 1925.

this table I have made many improvements over the previous model. As you will see here (Fig. 1) the side bars carrying the tube stand have been replaced by a fixed vertical rod which carries the tube holder, which can be raised out of the way when the table is not required for roentgenologic work.

Together with the Liebel-Flarsheim Company we have designed a flat Bucky-Potter diaphragm which can be inserted beneath the aluminum top of the table.

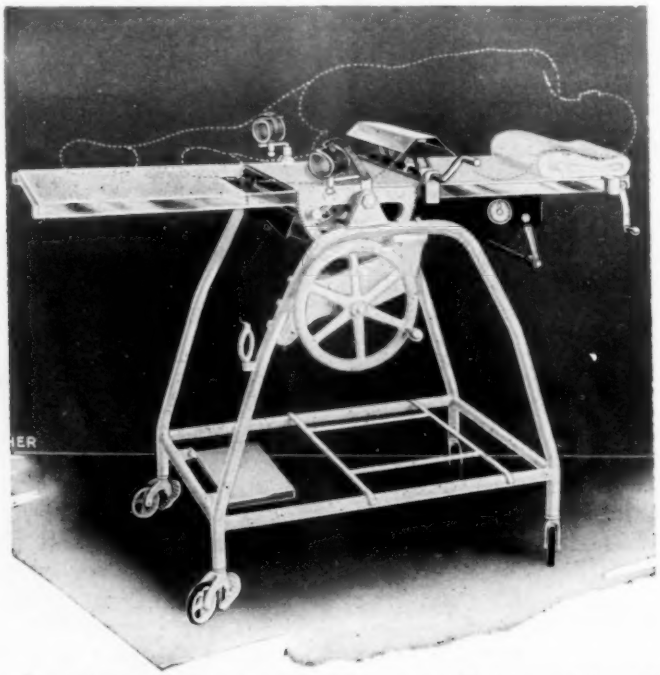

FIG. 1. Young's combined cystoscopic and roentgenologic examining table with new, specially designed flat diaphragm and the tube stand fixed with tube in focus on diaphragm. This is the same table as his operating table to which the roentgen-ray equipment is simply added. The table is in position for horizontal pyelograms.

In this diaphragm the grids run transversely, and experience has shown that it is far superior in results to the curved diaphragm which we used on our previous table. For the best roentgenographic results it is necessary that the distance between the bottom of the grid and the film be kept at a minimum. In the curved construction this distance is only at a minimum in the center of the film and progressively increases, to an inch or more, toward the outer edges (Fig. 2). In the flat construction this distance is at a minimum over the entire area of the film, as illustrated in Figure 3. It is obvious from a consideration of the construction of the flat grid that if the alinement of the lead strips is perfect for the center position of the grid, any movement from this position will result in a cutoff of the useful roentgen rays and will require a correspondingly greater exposure, but in actual practice no greater exposure is required than on the curved form. By refinements in the construction of the flat diaphragm and the mechanism which actuates it, it is possible to limit the grid travel during exposure to two inches or somewhat less and still secure freedom from grid lines on the film. With this travel the average value of the cutoff on a perfect grid would be about 10 per cent. Tests carefully conducted by the Liebel-Flarsheim Company have shown, however, that in practice a flat grid constructed in this manner requires no greater exposure than the conventional curved form. This is due to the fact that inaccuracies in the

construction of a flat grid are automatically compensated for during the travel of the grid, while in a curved form such inaccuracies remain constant throughout the entire travel of the grid. Since with the Bucky-Potter diaphragm the tube must be fairly accurately centered, the tube holder is fastened directly to the table top and is of great advantage as is also the fact that it moves with the table and remains accurately centered over the flat diaphragm whether in a horizontal, inclined or vertical position. In this it is a marked improvement over my original table with lateral bars. A friction swivel permits raising the tube holder arm out of the way, or the entire tube holder can be removed from the table by turning one thumb screw and lifting it out. One of the greatest advantages is the fact that the lead strips of the Bucky-Potter grid run crosswise of the table. Stereoscopic roentgenograms, which may be viewed in the upright position, can be quickly taken in all positions of the patient as the tube shift is transverse, as are the grid lines.

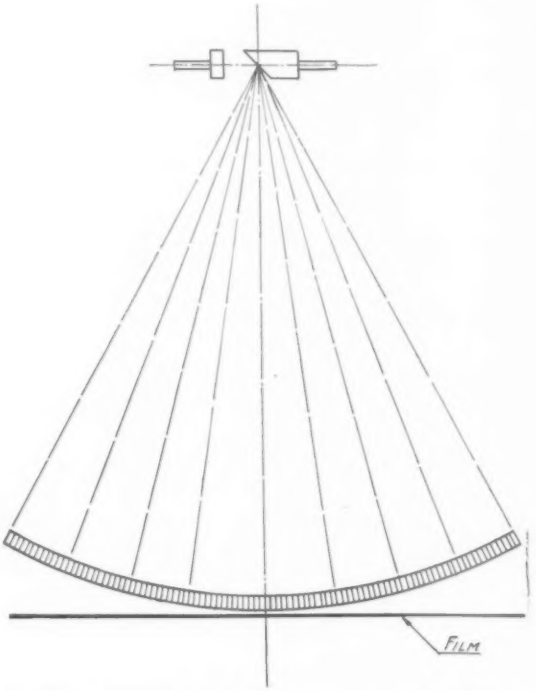

FIG. 2. Diagram showing construction and use of the Bucky-Potter diaphragm.

In this table we have also introduced a bakelite top about a quarter of an inch in thickness. Experiments have shown that this blocks off considerably less roentgen rays than the aluminum cover on the curved diaphragm and probably helps to some extent to preserve soft tissue detail. It has the further advantage that it is not affected by chemical substances used in urological work and that it does not chill the patient. Since our demonstration that this flat diaphragm is a practical advance of great value, it has been introduced for general roentgen-ray work now in connection with our urological table. The Liebel-Flarsheim-Young flat diaphragm will, therefore, we believe, eventually replace the curved Bucky-Potter diaphragm.

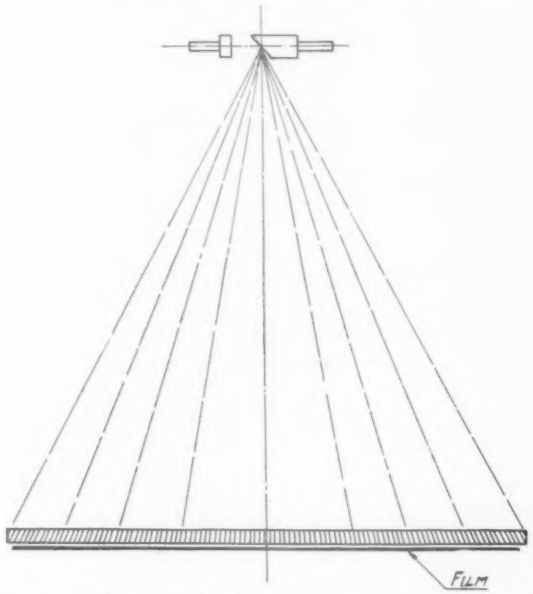

FIG. 3. Diagram showing construction and use of Liebel-Flarsheim-Young flat diaphragm.

As seen in the accompanying illustrations, the table is well adapted for urological work, being provided with multiple side bars which carry knee crutches on which the legs hang in the usual cystoscopic position and upon which the patient may sit when the position is changed quickly to vertical. Shoulder rests are also provided for the depressed positions. These are operated mechanically by a ratchet mechanism which makes for speed and accuracy.

METHOD OF USE

We may briefly summarize the technique employed in combined urological and roentgenological examinations with the newest model of our table.

Plain Roentgenograms. The top of the table is placed vertically. The legs are elevated with the crutches, thus reducing greatly the curve in the small of the back and causing the kidneys to approach closer to the table top (Fig. 1). A cassette carrying a 14 × 17 film is placed beneath the table by means of a simple hinged mechanism which brings it close to the undersurface of the grid which is in immediate juxtaposition with the bakelite top.

In order to see whether the kidneys are movable the patient is then placed in a vertical position (Fig. 4). In order to accomplish this the leg rests are elevated until perpendicular to the table top and the knee crutches pushed inward close to the table on each side. In this position they furnish a firm seat for the patient so that when the table top is brought to a vertical position the patient sits comfortably upon the knee crutches. The tube holder being in place no difficulty is experienced in immediately taking a roentgenogram which will often show considerable descensus of the kidney in pathological cases. As a rule, however, after a plain roentgenogram in the horizontal position, if accurate studies of the kidney are required, ureteral catheterization is carried out and after obtaining specimens for culture and microscopic study and phthalein test, a *pyelogram* is taken, generally on the supposedly affected side, using either thorium nitrate

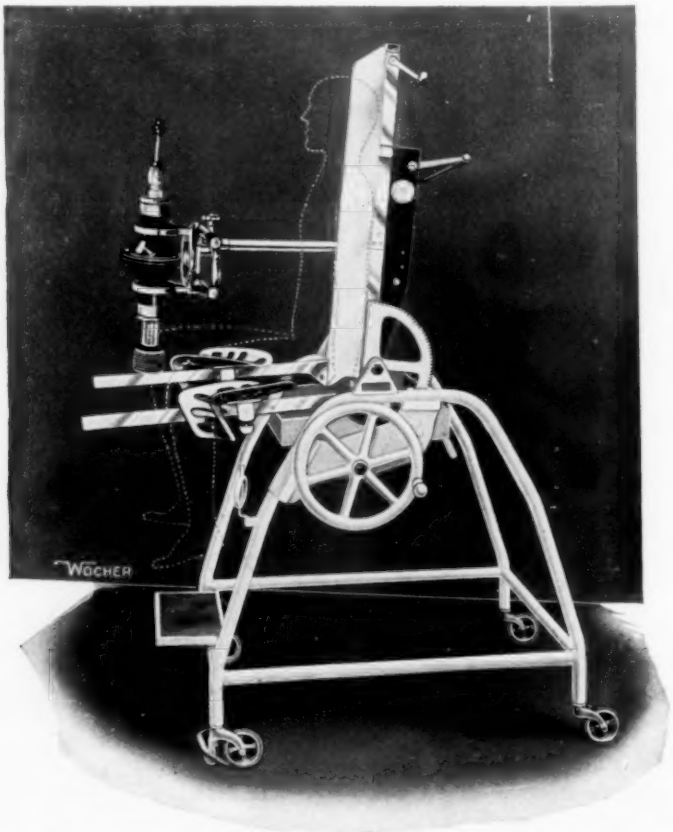

FIG. 4. Young's combined cystoscopic and roentgenologic table with patient in vertical position sitting upon the movable side bars. This position is used for vertical pyelograms which show the extreme movement of the kidneys.

FIG. 5. Case of movable kidney. Pyelogram taken with 15 per cent thorium nitrate. Patient in horizontal position.

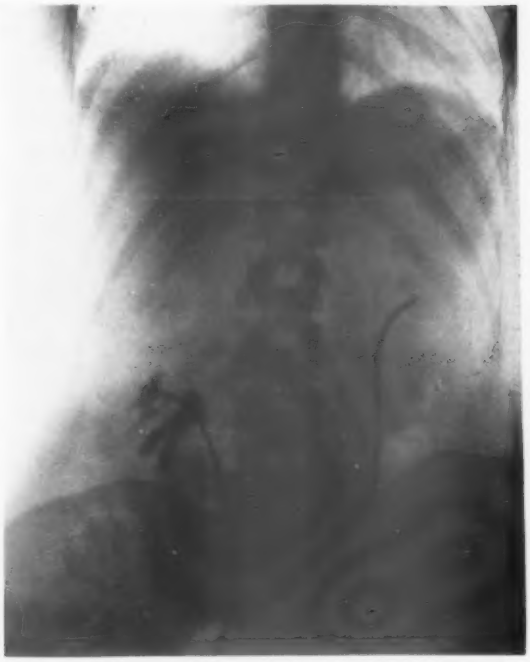

FIG. 6. Case of movable kidney. Pyelogram with 15 per cent thorium nitrate taken in vertical position showing considerable descensus and rotation of kidney. Compare with Figure 5 in horizontal position.

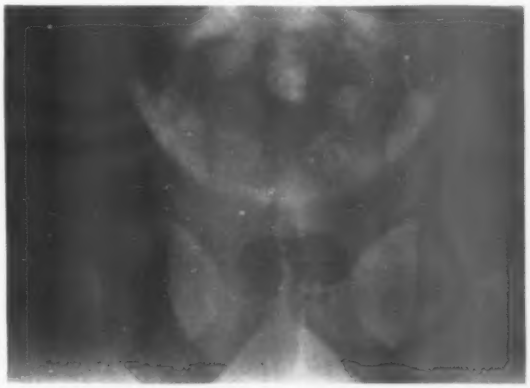

FIG. 7. Case of multiple calculi of the prostate. Roentgenogram taken with patient in ordinary cystoscopic position. Legs slightly elevated. Tube over lower abdomen.

FIG. 8. Same case of multiple calculi of prostate. Roentgenogram taken with thighs on level with table top. Tube over upper portion of abdomen and rays directed down the pelvic strait. The mass of calculi in the prostate is thus shown entirely within the pelvic space.

or sodium iodide 15 per cent as a pyelographic medium. It is our practice always to take pyelograms in the horizontal position and then in the vertical position as most important data as to the movement of the kidney, torsion or kinking of

desired to throw the shadow of the prostate well within the pelvic space the knee crutches should be lower so as to straighten out the thighs and tilt the pelvis downward. In this position the rays will pass more directly down the strait of the pelvis

FIG. 9. Stereoscopic films of a case of incontinence following suprapubic prostatectomy. Note the great dilatation of the prostatic urethra which forms a common cavity with the bladder, internal sphincter evidently having been destroyed. Diverticula also shown.

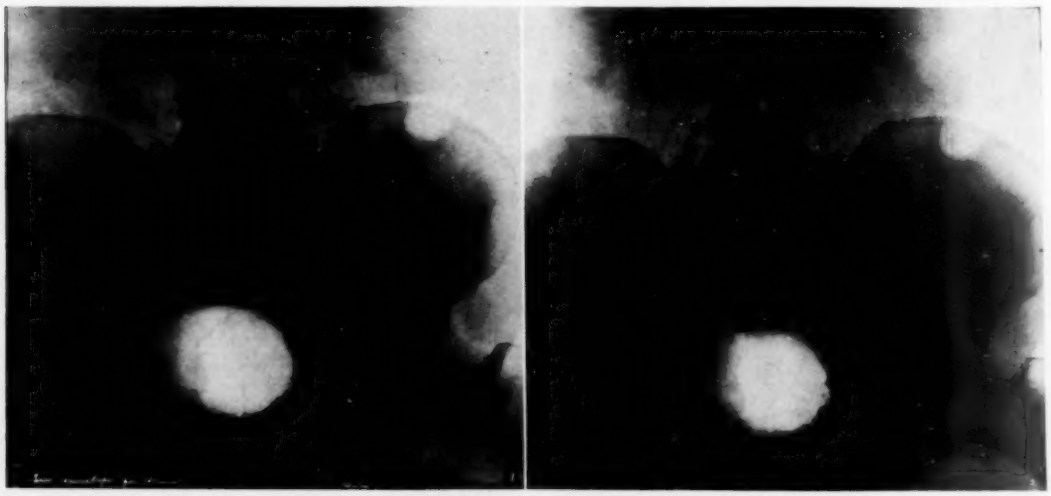

FIG. 10. Case of infiltrating carcinoma of the bladder. Air cystogram. Note the filling defect and extent of tumor as shown by stereoscopic study.

the ureters, etc., are thus displayed. Many supposed strictures of the ureter are thus disproved, and marked dropping of the kidney demonstrated (Figs. 5 and 6).

In study of the bladder the usual horizontal position is employed, but if it is

and the prostatic shadow will be seen within the confines of the pelvis, and not obscured behind the pubic bones (Figs. 7 and 8).

Cystograms. Either thorium nitrate, sodium iodide (10 per cent) or air is

employed, the latter being of particular value in the case of vesical tumors. Figures 9 and 10 show the value of stereoscopic cystograms in urological diagnoses.

With my combined cystoscopic and roentgenologic table I was the first apparently, to obtain roentgenograms of the seminal vesicles and ampulla of the vasa deferentia filled with shadowgraphic media through the ejaculatory ducts. This method has been described in an article by Waters and myself,[1] and has proved to be of great value in diagnosing pathological incontinence of urine and valves of the posterior urethra in children.

With removal of the standard carrying the roentgen-ray tube the table becomes at once a simple urological table which is not only satisfactory for examinations, but which may also be employed for the various major urological operations. A splendid Trendelenburg position is furnished as shown in Figure 17. This table has the great advantage that with the legs widely separated it is possible for the operator to make use of vaginal or rectal

FIG. 11. Showing the use of the tubular endoscope and injection of ejaculatory duct with thorium nitrate or silver iodide or argyrol for vesiculo-vasograms or for treatment of seminal vesiculitis.

conditions of the lower seminal tract and has replaced vasotomy for injection of seminal vesicles for therapeutic as well as roentgenographic use. Through my plain tubular endoscope the ejaculatory ducts are easily found in the verumontanum and injected as shown in the accompanying plates (Figs. 11, 12, 13, 14 and 15).

Urethrograms may be taken either in the horizontal or lateral position in order to show irregularities, strictures, diverticula, etc. (Fig. 16). Such studies are of considerable importance, particularly in cases of assistance during his operation or to place an assistant to hold the retractor beneath the separated thighs.

With the patient in the same position but with the table top horizontal a splendid position for operations upon the male genitalia (hypospadias, epispadias) is afforded, the operator being seated between the thighs.

For perineal prostatectomy and operations upon the perineum, urethra and rectum an admirable position as shown in Figure 18, is provided by means of our automatic perineal elevator (Fig. 19).

Figure 20 shows the operating table in horizontal position with a special

[1] Young, H. H., and Waters, C. A. X-ray studies of the seminal vesicles and vasa deferentia after urethroscopic injection of the ejaculatory ducts with thorium. Johns Hopkins Hosp. Bull., 1920, xxxi, 12–13.

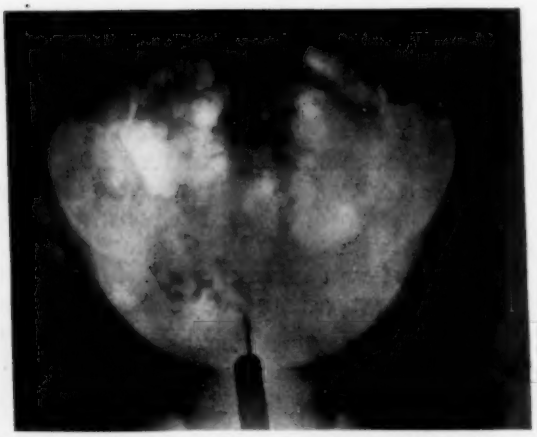

FIG. 12. Injection of right ejaculatory duct with 15 per cent thorium nitrate. Seminal vesicles and also the vas deferens are shown well distended with shadowgraphic medium.

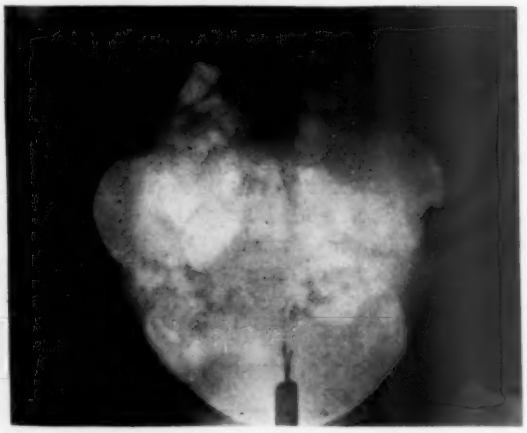

FIG. 13. Injection of both ejaculatory ducts simultaneously through bifid cannula. Both seminal vesicles are well filled. Vasa deferentia not filled.

kidney elevator for the lateral nephrectomy position. Padded discs to hold the chest and back vertical are provided but not shown in this cut.

FIG. 14. Vesiculogram and vasogram injected through single cannula. Junction of vas and seminal vesicles plainly shown.

In group practice in special hospitals when the table is not in use for urological examinations or roentgen-ray work, the roentgen attachment can be quickly demounted and the table employed by the urologist or operating surgeon for the special urological positions described above. This greatly increases the usefulness of the table, especially in such combined practice.

In conclusion, I may say that this new combined urologic and roentgenologic table with our flat diaphragm and fixed standard carrying tube holder has very greatly facilitated our work, has given us better and more accurate roentgenograms and has particularly made possible the use of stereoscopic films without which it is impossible to do accurate roentgenologic work of the urinary tract. This is particularly true where shadows in the line of the ureter and perhaps touching the outline of a ureteral catheter are shown in a roentgenogram, the stereoscopic plate at once will demonstrate that the ureteral calculus is in immediate contact with the catheter.

The importance of taking pyelograms in both the horizontal and vertical position cannot be too greatly insisted upon for accurate determination of the movement of the kidneys and pathological conditions which go with it. In this written paper I shall not describe a series of plates which I brought with me to demonstrate interesting cases in our clinic. I shall simply show these films to you as examples of the various types of lesions which occur and the difficulties of diagnosis which come up. So much has been written upon the changes in the calyces, pelvis and ureter in the various diseases of the kidney

FIG. 15. Drawing made from stereoscopic plates showing both vasa injected with 15 per cent thorium nitrate solution through urethroscope. Seminal vesicles not injected, probably owing to the fact that a long cannula was used which entered the vas deferens on each side. To inject vesicles cannula is introduced a shorter distance.

and the subject is so vast that I shall not take it up here. Suffice it to say that the ureteropyelogram is our most valuable diagnostic method for clearing up these puzzling conditions. The roentgenologist is of the very greatest necessity to the urologist in this work.

The same may be said for the various diseases of the bladder in which cystoscopy and roentgenology are so intimately associated in diagnostic work and treatment. Without the roentgenologist we would go back to the dark ages of urology.

I want next to refer to the close relationship of the urologist and roentgenologist in the treatment of cancer. I think there is no branch of medicine in which more can be done in this dread disease than in the urinary tract. In cancer of the bladder, if seen in an early stage, by means of high frequency, radium and the roentgen ray an absolutely curative result can be obtained in a large percentage of cases. For this purpose we have introduced a series of radium applicators (Figs. 21, 22 and 23) by means of which a large amount of radium (200 mg.) (as shown in Fig. 24) can be brought into close contact with cancer of the bladder without

FIG. 16. Roentgenogram with thorium nitrate 15 per cent in a case of valve of the prostatic urethra showing dilatation of the prostatic urethra above the valve, markedly dilated ureters, great dilatation of the right kidney which lies at the brim of the pelvis.

a cutting operation. The treatment of such cases is greatly enhanced by the use of deep roentgen therapy, particularly where the cancer is situated rather close to the anterior wall of the abdomen. Here again a combination of radium and roentgen-ray treatment is of the greatest value. In a study of our cases made by

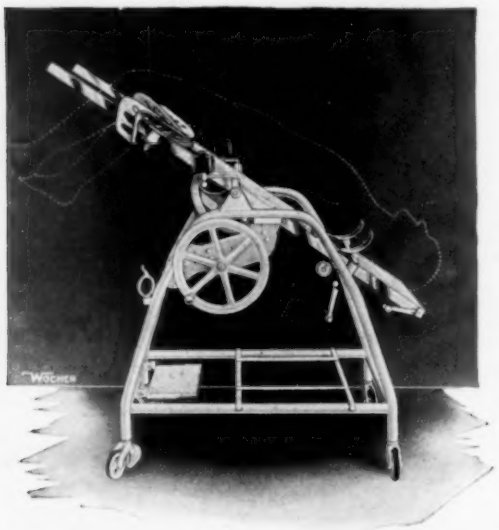

FIG. 17. Table in Trendelenburg position. Patient's thighs are separated and knees hang over crutches which slide upon the movable side bars.

Dr. Waters and myself,[1] there are 67 cases of bladder tumor which we find may be classified as follows: (1) papillomata, benign and malignant; (2) superficial and non-infiltrating carcinomata; and (3) infiltrating papillary carcinomata. From a study of these cases we have drawn the following conclusions:

(1) The best treatment for superficial carcinomata, whether localized or extensive is a combination of radium applications applied directly upon the surface of the growth, and deep roentgen therapy.

(2) By the combination of radium and roentgen radiation our results would seem to indicate that most of these tumors can be destroyed with a minimum amount of damage to the bladder and little or no irritation to the vesical mucosa.

When the growth is an infiltrating carcinoma but still operable, we believe that radical resection should be carried out as

[1] Young, H. H., and Waters, C. A. Pyelography. Transactions, La Société Internationale d'Urologie, Paris, 1921.

offering the most certain probability of complete removal. Twenty-five per cent of these infiltrating growths in our series occupy positions which render them inoperable, or they are so extensive that radical removal is impossible. In this group where it is possible to apply radium directly to the growth and also to give deep

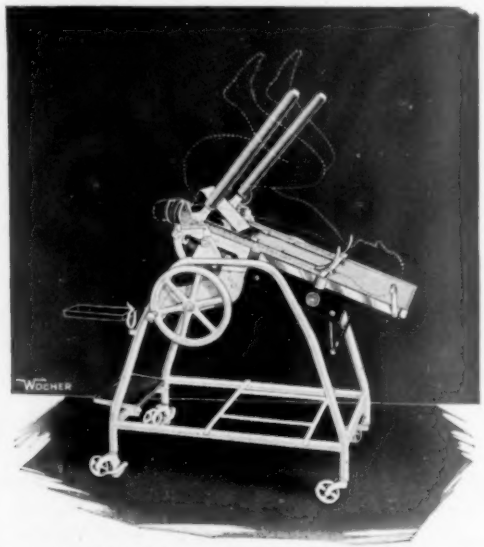

FIG. 18. Table with patient in position for perineal and rectal operations. Legs supported by movable side bars covered with rubber tubes. Pelvis flexed on spine with Young's automatic perineal elevator.

roentgen therapy before the carcinoma has progressed too far, a certain number of excellent results have been obtained. Where this is impossible or does not give satisfactory results, suprapubic cystotomy

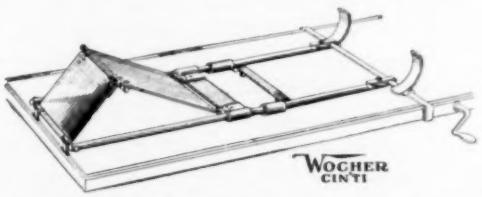

FIG. 19. Young's automatic perineal elevator operated by rack and pinion mechanism which moves the shoulder rests forward, at the same time elevating the pelvis. When elevator reaches maximum position an automatic release on each side allows the shoulder rest to continue movement until patient is pushed up into the proper position.

with implantation of radium needles should be carried out and may in a few cases be very effective. While there have been many disappointments, there have, on

the other hand, been many remarkable cures obtained by means of radium, roentgen radiation and fulguration in the treatment of benign or malignant tumors of the bladder.

in restoring almost normal urination and in a few cases radically curing the patient. In prostatic and retrovesical sarcomata extraordinarily good results have been obtained by a combination of radium and

FIG. 20. Young's operating table in horizontal position with special kidney elevator for lateral nephrectomy position; padded discs to hold patient vertical are not shown. Flat Bucky-Potter diaphragm shown in this table is not supplied on tables for purely operating room work.

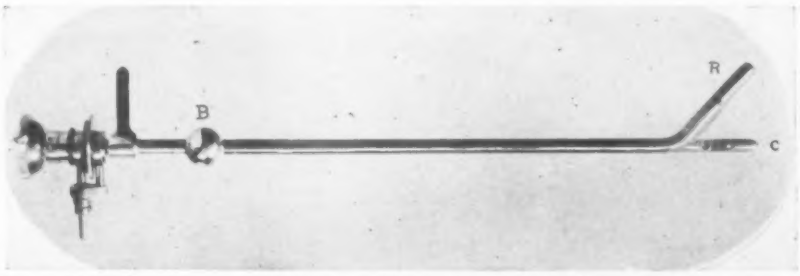

FIG. 21. Young's cystoscopic radium applicator with ball (b) externally for attaching fixation clamp; (c) cystoscope; (r) radium in platinum tube.

My time is too limited to discuss also the remarkable results which have been obtained by the local application of radium and deep roentgen therapy in cancer of the prostate. Suffice it to say that really remarkable results have been obtained

deep roentgen therapy. We have had cases of immense tumor masses which have disappeared completely and patient has remained well for several years. In certain rare tumors equally good results have been obtained, but in carcin-

oma the results have been thoroughly unsatisfactory.

I might state that Dr. Waters uses four portals of entry: back and front and 50 cm.; portal of entry front and back 20 × 20 cm. and sides 10 × 15 cm. The erythema or skin dose is 135 min. with 4 ma.

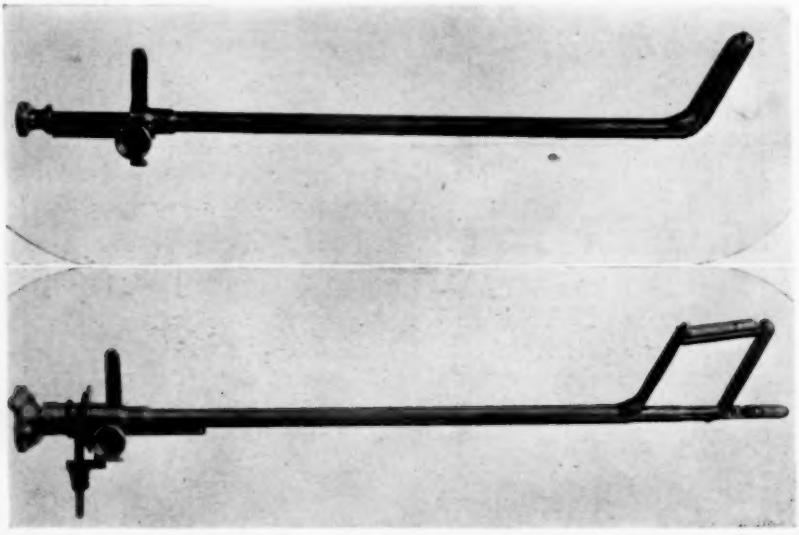

FIG. 22. Young's parallelogram cystoscopic radium applicator for vesical tumors of the lateral wall of the bladder.

FIG. 23. Young's applicator, carrying one or two tubes of radium 100 mg. each in platinum tubes, the beak being composed of silver surrounded by gutta-percha. Note the ball to which a fixation clamp is attached, thus holding the radium firmly in place.

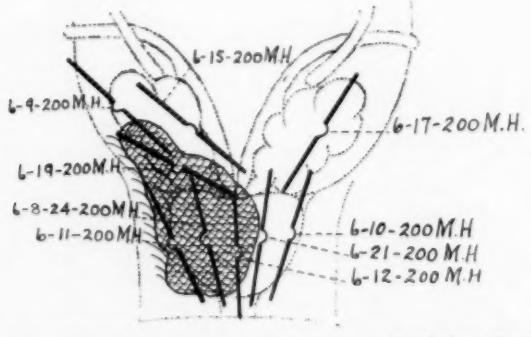

FIG. 24. Chart of a case of carcinoma of the prostate involving the left lobe and left seminal vesicle; the various applications of radium, the date and amount of milligram-hours. On intervening days radium is also applied through the urethra and trigone to carcinomatous areas.

on each side. The factors used are, 200,000 volts with 4 ma., through, 1 mm. copper plus 1 mm. aluminum, focal distance

This treatment is given in fractional doses consisting usually of 25 minutes at each sitting. Treatments are given daily

and require twenty days, five days for each portal of entry. The last day's treatment consists of 35 minutes. This constitutes one series of deep roentgen treatments with a dose of about 130 per cent.

Patients are instructed to come back in a month or six weeks for further examination. Even where a cure is not obtained, especially in cases of carcinoma with metastases, remarkable amelioration and even complete disappearance of severe pain is very frequently obtained. Slides which I will show you will demonstrate the methods of radium application and deep roentgen therapy to which I have referred. However, I have not the space to give this in a written paper.

In conclusion, I wish to say that the cooperation between the urologists and roentgenologists has resulted in, I believe, the greatest advancement which has been made in medical science in recent years, but there is much to be done, many new fields to explore and many problems which will require further study and investigation. The future is indeed very bright and will, I believe, see the two most scientific fields of medicine combined in researches upon their mutually interesting problems.

FIG. 25. The Liebel-Flarsheim-Young flat diaphragm for general usage where Bucky-Potter diaphragm may be employed.

ROENTGEN FINDINGS IN THE UNCOMMON CAUSES OF HEMOPTYSIS*

BY D. S. BEILIN, M.D.

CHICAGO, ILLINOIS

IT is the purpose of this paper to emphasize the roentgenological findings in the uncommon causes of hemoptysis. This study is based upon 495 cases referred from the wards and the outpatient department of the Massachusetts General Hospital for a roentgenological examination of the chest.

The various causes of hemoptysis as revealed at autopsy have been graphically described by Cabot,[1] and it is quite obvious, as he states, that the spitting of blood in any considerable quantity, or the presence of a blood-streaked sputum may be due to many causes. Phthisis and mitral disease, the most common causes of hemoptysis, are well understood, and will not, therefore, be considered in this paper.

The uncommon causes of pulmonary hemorrhage are: lung abscess, neoplasm, bronchiectasis, foreign bodies, chronic bronchitis with asthma, pneumonoconiosis, chronic infections due to actinomycosis, blastomycosis, streptothricosis, pneumonia, syphilis, acute lymphatic leucemia, and other unspecified causes.

Greer[2] has reported 33 cases of lung abscess, in which the clinical features in some of the cases were blood-tinged sputum to copious hemorrhage. Fried[3] found hemoptysis not infrequent in primary carcinoma of the lungs. Bezançon and Azoulay[4] have classified bronchiectatic hemoptysis, and believe it to be a part of the ordinary picture of bronchiectasis. Conner[5] states that in lung abscess the sputum may be blood tinged, or a frank hemorrhage may occur, but he makes no mention of hemoptysis occurring in bronchiectasis. Bissell[6] discusses the differential diagnosis of certain chronic lung lesions, and points out that chronic lung infections, due to other organisms than the bacillus of tuberculosis, have not received much attention from pathologists because they do not directly cause death; and that they are usually unrecognized by clinicians. They are, however, of frequent occurrence, and may be observed roentgenologically. Walsh[7] noted the frequency of hemoptysis in association with epidemic colds in patients with pulmonary tuberculosis. It is of interest to note that Schwarz[8] observed hemoptysis in broncho-pulmonary spirochetosis. The literature is very scant regarding the incidence of hemoptysis in the mycotic infections of the lung. In all probability, this is due to the failure of persistent examination of the sputum for the specific organism.

A roentgenoscopic examination and a stereoscopic study of the roentgenograms will early reveal a pulmonary lesion and its probable nature. Holmes states that although it is often impossible to make a definite diagnosis of tumor, tuberculosis, and other diseases, the roentgenological examination nevertheless does show the presence of a lesion, and directs the clinician's attention to it. This is of great importance in those cases which give no clinical evidence of their presence. A careful correlation of the roentgenological findings with both the clinical history and the physical and laboratory data usually makes a diagnosis possible.

REPORT OF CASES

The following histories are illustrative of the cases studied:

CASE 1. A chauffeur, aged thirty-eight, was admitted to the hospital. Family and past histories are negative.

Present Illness. Patient had been perfectly well up to four and one-half weeks before the date of admission, at which time he had malaise, weakness and fever. About four days from the onset he had pain in the left upper chest; and raised thick, yellow, foul sputum which was streaked with blood. On many occasions the sputum was blood stained. The amount of sputum has been as much as two ounces in one day.

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Physical Examination. The patient was slightly emaciated, was raising foul sputum, and had marked pyorrhea; otherwise the findings were negative except for the condition in the chest. The upper, left chest was dull with diminished breath sounds and a few moist râles at the lower margin of this area. Respiratory movements were greater on the right side.

Laboratory Findings. Blood: W.B.C. 12,000 to 10,000. Wassermann: negative. Urine: negative. Sputum: three examinations negative for tubercle bacilli. Mixed infection.

Roentgen Findings. There is an area of increased density in the left upper chest. Just

FIG. 1. Case I. Lung abscess involving the left upper lobe. Fluid level can be seen at the first interspace.

below the first rib level, there is an area of increased radiance, which represents an abscess cavity, the lower border of which is apparently flat and represents the level of a small amount of fluid. Its surface shifts with change in position of the patient. The findings are those of abscess in the left upper chest.

Lung abscess must be differentiated from tuberculosis, bronchopneumonia, and bronchiectasis. In tuberculosis, the cavities are usually empty; the apices, as a rule, are involved; the sputum is rarely foul; and the history and clinical course will determine the diagnosis. Bronchopneumonia produces a shadow of a more mottled density, and is, as a rule, bilateral. There is no cavity formation. Bronchiectasis is usually a diffuse process, and the bronchial changes are more extensive.

CASE II. A woman, aged twenty-three, entered the hospital in July, 1924, with a preliminary diagnosis of tuberculosis or Hodgkin's disease. Family history is negative. Past history: typhoid fever at four years of age.

Present Illness. Patient's trouble began two years before entering the hospital, at which

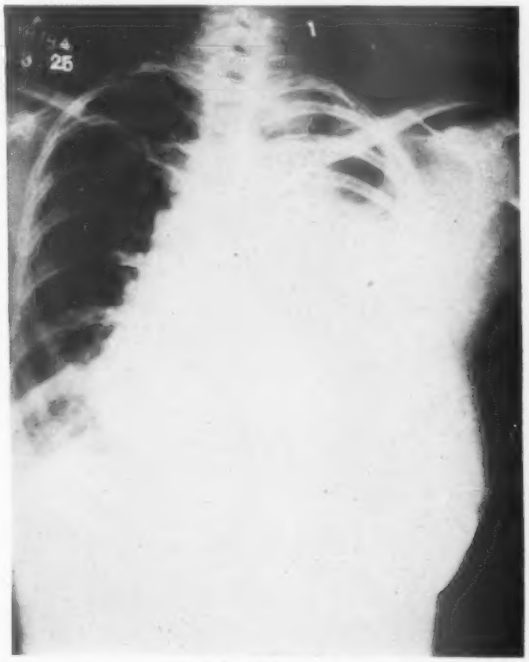

FIG. 2. Case II. Marked increased density of entire left chest. A dense shadow can be seen extending upward from left hilus. Note the separate nodule at the apex.

time she had influenza-pneumonia involving the left chest. She also had a pleurisy at the same time. The left chest was tapped, and a clear fluid drawn. Since that time, she has had a cough, a shortness of breath, and has raised streaks of blood. She has also had what she calls several attacks of pneumonia, and a loss of 52 pounds in weight.

Physical Examination. The entire left chest is dull, bulges slightly, and does not expand with inspiration. The heart is displaced to the right, but otherwise is negative.

Roentgen Findings. There is a marked increase in the density of the entire left chest, particularly in the mid and lower portions. A dense shadow can be seen extending upward

from the left hilus. At the apex, the shadow suggests a separate nodule. The heart, trachea and esophagus are displaced to the right. A barium meal passed through the esophagus without delay. The costophrenic angle and the outline of the diaphragm are obliterated on the left. The right chest is normal. The findings are very suggestive of fluid in the left chest associated with an infiltrating process in the left lung.

Operative Findings. Incision over the seventh interspace on the left; ribs retracted; pleura opened, exposing a large, hard tumor, which, upon palpation, seemed to extend from well toward the apex down to the diaphragm. It apparently was too large and adherent for removal. A considerable portion of the tumor was cauterized with the actual cautery. The tumor was excised on three different occasions.

Pathological Findings. Specimen shows carcinomatous tissue. The cells are not characteristic. It is possible that this may be a primary tumor of the pleura, but I do not make this diagnosis (Dr. J. H. Wright).

This patient has had a series of short wave therapy. On February 3, 1925, she was apparently in good condition. The roentgenogram, however, shows findings very similar to those previously described.

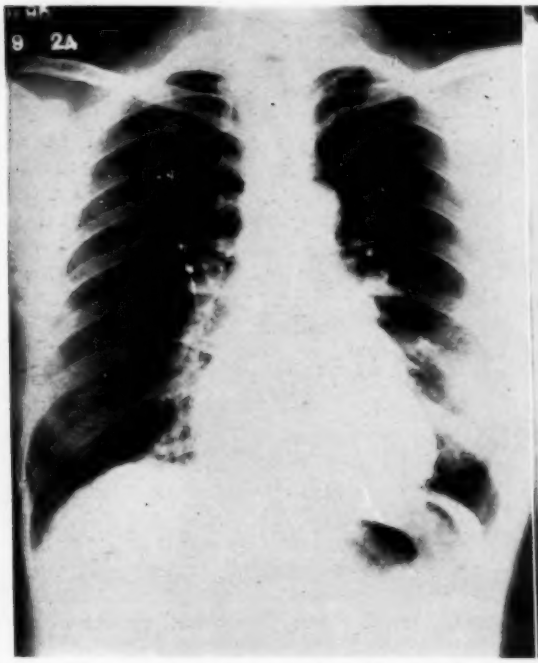

FIG. 3. Case III. Note the normal position of the left diaphragm and heart, also the clearness of the left costophrenic angle.

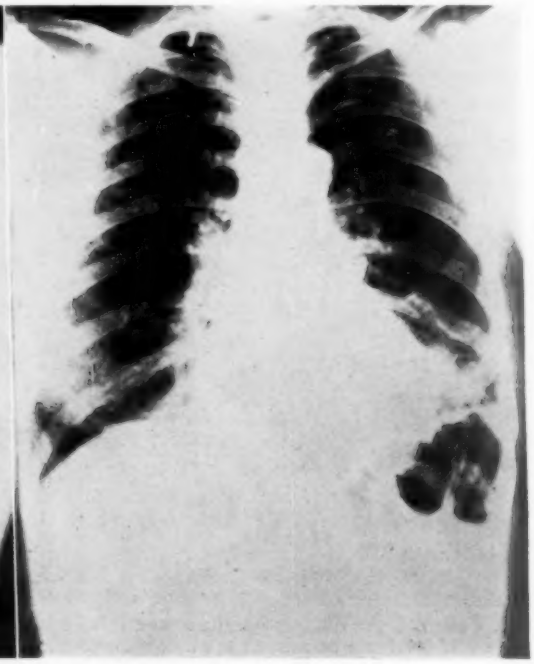

FIG. 4. Case III. The left diaphragm is now elevated; the heart displaced toward the affected side; and the left costophrenic angle is obliterated.

The gross anatomic appearance of lung tumors is very variable, and there are no well-defined gross types. They are frequently described as (1) a nodular form, (2) infiltrating form, and (3) miliary carcinosis. These terms are used frequently in classification, although obviously they are applicable to stages in the growth of a tumor rather than to distinct types of tumor. A knowledge of the gross pathological characteristics of primary lung carcinoma is fundamental, not only in the interpretation of the physical and roentgen findings, but also in the synthesis of the information derived from these two methods.

CASE III. A woman, aged fifty-five. A re-entry case with a previous diagnosis of chronic bronchiectasis, and a question of primary lung carcinoma. Family history: husband and daughter both had syphilis. Past history: patient had lues thirty-one years ago which was characterized by a local sore, copper spots on face, and alopecia. Husband had the same infection at that time. On September 11, 1923, the patient was admitted to the hospital

for a possible malignancy of the lungs. She was given a series of short wave therapy.

Present Illness. Patient's trouble started in August, 1923, at which time she coughed up foul, pus-like sputum two to three times a week, with considerable hemoptysis. She was sent to a tuberculosis sanitarium by her local doctor. In December, 1924, she had a pulmonary hemorrhage associated with productive sputum.

Physical Examination. The examination revealed slight, diminished expansion of left chest, and dullness over the entire lower left back associated with numerous coarse râles.

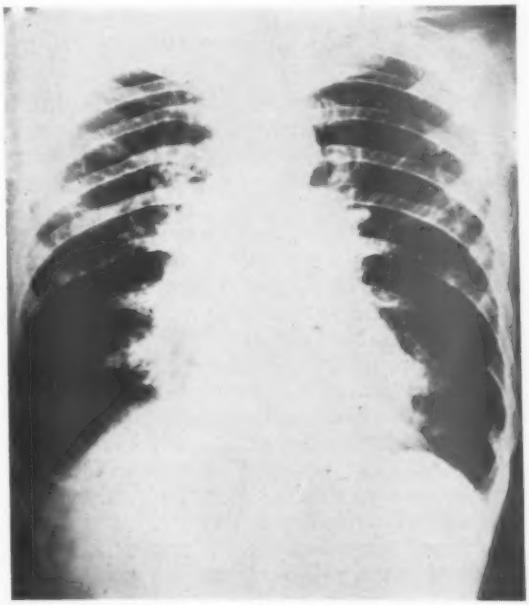

FIG. 5. Case IV. There is a diffuse process throughout both lungs, characterized by fine mottling and dense linear shadows.

Laboratory Findings. Blood: W.B.C. 8,400 to 10,900. Examination of sputum for bacillus of tuberculosis found to be negative on nine different occasions. Wassermann: negative; spinal: not taken.

Roentgen Findings. 6–9–24. There is an area of increased density at the left root which extends outward a little beyond the mid-chest. The descending bronchi on both sides, particularly the left, are increased in density. The diaphragms are normal in position, and the costophrenic angles are clear.

3–6–25. The diaphragm is high on the left side. The costophrenic sinus is obliterated, and apparently fixed in the axillary border. There is increased density along the left descending bronchus. The heart is slightly displaced toward the affected side. The findings are very suggestive of bronchostenosis with partial collapse of left lower lobe.

This patient has had syphilis, and her pulmonary condition may well be explained on the basis of syphilis of the bronchus.

CASE IV. A woman, aged twenty-nine. Patient entered the hospital in April, 1915, with a chief complaint of asthma for fourteen years. Family history: negative. Past history: measles and smallpox. No other illness, except asthma.

FIG. 6. Case V. There is a triangular area of dullness, which has its base on the axillary border, and its apex at the hilus. The fluid level is seen at the third interspace.

Present Illness. For fourteen years, patient has had attacks of difficult breathing, with cough, and productive sputum; wakes up two or three times at night with an attack. Relieved by smoking, powders, and adrenalin. Diagnosis: bronchial asthma—emphysema.

In June, 1916, she came into the hospital because of hemoptysis and marked coughing. Several examinations of the sputum were negative. From 1916 to March, 1925, she has had exacerbation of asthmatic attacks, with blood-spitting.

Physical Examination. The examination reveals a young woman said to be twenty-nine years of age, with typical asthmatic breathing, and many coarse râles throughout both

lungs. Heart, abdomen and extremities are negative.

Laboratory Findings. Blood pressure 120/78. Wassermann: negative. Sputum: eight examinations negative for tubercle bacilli. Patient is sensitive to oat, wheat, barley, ragweed, timothy and June grass.

Roentgen Findings. There is a diffuse process throughout both lungs, characterized by fine mottling and dense linear shadows. This process is more marked on the right side. The hilus areas are markedly increased in size and density, particularly the right. The heart shadow is not remarkable. The appearance is that of a chronic, fibrosing process of both lungs, and consistent with bronchial asthma.

CASE V. Patient, a woman, entered the hospital January 18, 1925 with a chief complaint of pain in the back and right side, and cough.

Present Illness. About a year and a half before entering the hospital, the patient had a tooth extracted, without anesthetic. No immediate symptoms followed, but about nine months later, she had a generalized epileptiform convulsion. It came on without warning. She lost consciousness and fell into a deep sleep. She has had two similar attacks since that time. Four or five days after the last convulsion she had cough, bloody, yellow sputum, and pain in right side. She had been at the Boston City Hospital three times for this condition. At each admission, she was sent in for operation, but it was refused. While in the hospital, she coughed violently, had a gush of blood from her lungs, and the drainage of foul sputum became profuse. Her present trouble is similar to her previous entries at the City Hospital.

Physical Examination. Patient coughs at intervals; has foul breath; teeth are carious. Chest shows dullness to flatness, right lower lobe. Râles over lower portion. Heart: some enlargement; faint systolic at the apex. Fingers show moderate clubbing.

Laboratory Findings. Wassermann reaction: negative. Examination of sputum for tubercle bacilli negative on four occasions. Cultures reveal many cocci and influenza bacilli.

Roentgen Findings. 1–21–25. The lower half of the right chest is less radiant than the left. The density is of a mottled character, and extends to the periphery. The outline of the diaphragm is somewhat hazy. The findings suggest consolidation in the lower, right chest.

3–5–25. There is a triangular area of dullness which has its base on the axillary border, and its apex at the hilus. Its lower border obliterates the costophrenic angle. The outer part of the diaphragm is apparently adherent. The fluid level is at the third interspace. The findings are very suggestive of lung abscess.

Medical Opinion. Etiology of the lung abscess: due to inhalation of non-opaque, foreign body during one of the convulsions.

CASE VI. A fur-maker, aged fifty. Patient entered the outpatient department on February 5, 1925. Family history: negative. Past history is good. Two years before entering the hospital, he began to cough, raising blackish sputum streaked with blood. He has raised blood on and off for some time, especially in the morning. He suffers from shortness of breath and fatigue; has lost no weight; has no fever, nor night sweats.

Physical Examination. Patient shows fair nutrition. Both lungs are hyper-resonant over the anterior chest, with transitory, musical râles.

Laboratory Findings. Blood and urine are normal. Blood pressure: 139/90. Three examinations of sputum were negative for tubercle bacilli.

Roentgen Findings. There is a diffuse, fine mottling symmetrically distributed throughout both lungs. There is a distinct increase in the lung markings, and the lung fields appear less radiant than normal. The outline, position, and respiratory excursion of the diaphragm do not appear abnormal. The findings are those of pneumonoconiosis. Miliary tuberculosis should always be excluded. It can be excluded, however, when the following findings are present: (1) a long history of occupational exposure to dust; (2) a negative family and past history for tuberculosis; (3) a clinical history lacking to account for the extensive findings in the picture, and (4) repeated examinations of the sputum negative.

In lobar pneumonia, the amount of blood expectorated in the majority of cases is slight, and generally the blood is only sufficient to give the sputum a rusty color. It may, however, in a few cases be copious enough to be in itself alarming. Lobar pneumonia must be differentiated from phthisis, or from pneumonia superimposed upon phthisis. The diagnosis is often obvious enough, but sometimes, notwithstanding the typical onset of the disease, the physical findings may be abnormal, and a roentgenogram may often serve to differentiate between phthisis and lobar pneumonia.

Roentgen Findings. Lobar pneumonia is characterized by areas of increased uni-

form density, which are sharply defined when fully developed, usually occupying the position of a lobe. The shadow usually seen is triangular in shape with the base on the pleura and the apex toward the hilus. The character of the shadow changes with the progress of the disease, and, as resolution appears, it becomes distinctly mottled. Thickened bronchial markings, or large glands, may persist for a considerable time after the shadow itself has disappeared.

Bronchiectasis may be associated with hemoptysis; in fact, Bezançon and Azoulay believe it to be a part of the ordinary picture of this disease. Bronchiectasis is usually accompanied by fibrosis of the lung. The sacular type is highly hemoptotic in contradistinction to the cylindrical type of bronchiectasis.

Roentgen Findings. The characteristic picture in a well advanced case is extensive thickening of the lung markings along the course of the larger bronchi, and enlargement of the hilus glands. In the lung fields, near the bronchi, there are single or multiple areas of increased density, which may show considerable change in films taken before and after evacuation. In the early stages, small, ring-like shadows of dilated bronchi may be seen; later, cavities can often be demonstrated.

The fungi infections of the lung not infrequently cause hemoptysis. Roentgenologically, they may occur in the form of lung abscess. However, the diagnosis depends upon bacteriological investigations of the sputum by cultural methods.

CONCLUSIONS

A roentgenoscopic examination, and a stereoscopic study of the roentgenograms will point to a pulmonary lesion and its probable nature in eliciting the uncommon causes of hemoptysis.

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REPORT OF 5000 GASTROINTESTINAL EXAMINATIONS BY THE ROENTGEN RAY*

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THE value of roentgenologic study of the gastrointestinal tract in the diagnosis or exclusion of pathology has long been conceded and this report can hope only to present briefly the results of routine examinations as made in a busy general clinic, to demonstrate the reliability of roentgen findings and by errors of omission and commission to emphasize the necessity of thorough study and the value of experience and training in this work.

The technique was practically the same as that described by Holmes[1] in a previous report. Our belief is that an observer deciding upon a technique by which he can get the best results will do the most consistent work by varying his technique only as necessitated by the requirements of special cases and as indicated by advancements in knowledge in his specialty. Methods will be influenced by the class of patients, the size of the clinic, the length of time patients can be kept under observation, the convenience of the patients, etc. With a mixed clinic of several nationalities, mostly outpatients, working people who can spare but little time if not sick enough to be in bed, the technique should be the simplest and most uniform consistent with the greatest general accuracy. We realize that in this routine method some of the less common conditions may be overlooked and some points of professional interest not so vitally important to the immediate case may be missed. A more thorough study with the patient more completely under the control of the roentgenologist might reveal further details.

We believe in disturbing the daily routine of the patient as little as possible in order to get a correct picture of his tract as it is behaving during the existence of his symptoms. Medication which will change the action of the tract immediately before or during the examination is avoided. As the motility of the tract is often an important point in the study we prefer that the patient should refrain from the use of laxatives for a few days if possible. We prefer no preliminary cleaning out except in special cases, as in certain suspected conditions of the cecum and colon. Drugs which affect gastric secretion or activity should be avoided when possible. The patient should come fasting to avoid the presence of food remnants in the stomach.

In a general clinic the vehicle for the opaque meal must be chosen which meets the least objections as to its unpalatability; it must be negative in its effects on the gastric action, and must affect the stomach as nearly as possible like any soft food. We have chosen a thin mixture of cooked starch and a small amount of malted milk.

We have chosen the roentgenoscopic instead of the serial plate method for several reasons. Its economy is obvious. It saves time and necessitates fewer visits by the patient. We believe that there is much valuable information to be gathered in watching the action of the viscera on the screen, and that a trained observer can recognize any abnormality on the screen that can be recorded on the plate. Valuable observations can be made by palpation under the screen.

By the two-meal method the gastric motility and emptying time can be more easily studied and the patient saved one visit. The patient is seen six hours after a barium meal with a very light breakfast and the progress of the meal noted. At this time the second meal is given and observation of the esophagus, stomach, duodenum, ileum and cecum is made. The patient is directed to refrain from laxatives and enemas and further observation may be made as the case may indicate. Whenever indicated, further observation of the colon is made by opaque enema

[1] Holmes, G. W. *Boston M. & S. J.*, 1916, clxxiv, 531.

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after thorough evacuation by cathartic and plain enema.

As the historical, clinical, physical and laboratory findings, etc. are often so important in differentiation they should always be studied with the roentgen findings either before or after the observation, at the choice of the roentgenologist. Our patients are sent to us with a simple requisition for study of the gastrointestinal tract, sometimes with a question of suspected pathological condition. Frequently no clinical study has been made of the case. No record accompanies the patient.

The following is an outline of the study and findings in 5000 cases comprising the work of about two years in the mixed clinic of a general hospital including private cases, outpatients and house cases. Classified by their roentgen findings an attempt has been made to compare these findings with both the clinical diagnosis before examination and the final diagnosis, either clinical or surgical.

Considering the group of cases as a whole we find that of the total number (5049) examined, 818 were explored surgically. In 768 the findings were confirmed in detail. In 44 more a surgical condition was found of different pathological nature or in adjacent structures. In only 5 where pathology was suspected by the roentgen ray no lesion was found at operation. In 11 cases diagnosed as "no lesion found" by roentgen examination, pathology was found by the surgeon.

The pathological conditions missed are interesting as illustrating the conditions likely to be overlooked, and the circumstances under which they are missed. Of the 11, 5 were diagnosed surgically as chronic appendicitis. No objective signs were found by roentgen examination. No tenderness was present. Disregarding the possibility of a surgical error, when we consider the frequency with which chronic atrophic changes or the relics of past inflammation are found in appendices removed at routine appendectomies the discrepancy in those cases is not remarkable. Jejunal ulcer was found in one case presenting clinical symptoms justifying exploration but giving no visible evidence at roentgen examination. One case of mediastinal cancer was found to involve the wall of the esophagus without causing obstruction. Cancer of the colon and rectum was found in 2 cases and one respectively which might have been discovered had the large bowel been examined by opaque enema, which was not done.

The provisional clinical diagnoses compared with the operative and roentgen findings in this group of cases were as follows:

TABLE 1

Operative	Clinical	Roentgen Ray	
Chronic appendicitis	Gallstones or duodenal ulcer	No lesion found	1
Chronic appendicitis	Gallstones or gastric ulcer	No lesion found	1
Chronic appendicitis	Duodenal ulcer	No lesion found	1
Chronic appendicitis	Ulcer	No lesion found	1
Chronic appendicitis	Appendix or gall-bladder	No lesion found	1
Duodenal ulcer	Gastric ulcer	No lesion found	1
Duodenal ulcer	Gallstones or ulcer	No lesion found	1
Jejunal ulcer	None	No lesion found	1
Cancer of the colon	Intestinal obstruction	No lesion found	1
Cancer of the colon	Malignancy (not located)	No lesion found	1
Cancer of the rectum	Cancer (not located)	No lesion found	1
			11

If we eliminate the 5 cases with the very questionable diagnosis of "chronic appendix" and the 3 cases of cancer of the large bowel in which the examination was not completed, this leaves 3 failures to recognize pathology and 5 where no lesion was found. Counting all the 11 lesions overlooked and the 5 where no lesions were present if the surgeon was correct in his findings gives us 16 errors out of 818 or about 2 per cent.

Negative Cases. In a group of cases many of which are referred for study with no definite gastrointestinal symptoms or with some constitutional conditions in which it is desired to eliminate the question of gastrointestinal pathology, it is to be expected that the proportion of negative findings will be large. In our series 2176 were reported as "no lesion found." Of these 117 were explored.

The provisional clinical diagnoses compared with the operative and roentgen findings in this group of cases were as follows:

TABLE II

Operative Findings	Provisional Clinical Diagnoses		
Gall-bladder disease			
Gallstones	Gallstones	6	
Gallstones	Galstones or ulcer	1	
Gallstones	Gall-bladder disease	1	
Gallstones	Gall-bladder disease or ulcer	2	
Gallstones	Duodenal ulcer or gallstones	1	
Gallstones	Gastric cancer or gall-bladder disease	1	
Gallstones	Gastric ulcer	3	
Gallstones	Gastric cancer	1	
Gallstones	Ulcer	2	
Gallstones	Malignancy	4	
Gallstones	Gastrointestinal lesion	1	
Gallstones	Tuberculosis	1	
Gallstones	None	1	
Cholecystitis	Gall-bladder disease	1	
Cholecystitis	None	3	
Cholecystitis	Gallstones	1	
Cholecystitis	Gallstones or ulcer	1	
Cholecystitis	Duodenal ulcer	1	
Cholecystitis	Cancer of the pancreas	1	
Cholecystitis	Abdominal pain	1	
Adhesions to gall-bladder	Ulcer or adhesions	1	
Adhesions to gall-bladder	Gallstones	1	
Congenital band to gall-bladder	Ulcer, stone or cancer	1	
Obstruction of common duct	Obstructive jaundice	1	38
Gynecological conditions			
Prolapse	Gall-bladder disease	2	
Prolapse	Stone or ulcer	1	
Prolapse	Gastric ulcer	1	
Prolapse	None	1	
Endometritis	Abdominal pain	1	
Endometritis	None	1	
Incomplete miscarriage	Gallstones or gastric cancer	1	
Incomplete miscarriage	Gastric ulcer	1	
Ovarian tumor, malignant	None	1	
Cancer, ovary, metas. to liver	Cancer of liver	1	
Ovarian cyst	Cyst of mesentery	1	
Uterine adenoma	Abdominal pain	1	
Fibroid	Indigestion	1	
Tuberculous salpingitis	Catarrhal jaundice or gallstones	1	15
No disease	None	5	
No disease	Gastric cancer	2	
No disease	Ulcer	2	
No disease	Duodenal ulcer	1	
No disease	Duodenal ulcer or spasm	1	
No disease	Appendix or ovarian tumor	1	
No disease	Adhesions	1	
No disease	Cancer of the sigmoid	1	
No disease	Abdominal tumor	1	15

TABLE II.—*Continued*

Operative Findings	Provisional Clinical Diagnoses		
Diseases of the liver			
Cirrhosis	Jaundice	2	
Cirrhosis	Cancer of the liver	2	
Cancer	Cancer (not located)	1	
Cancer	Malignancy (not located)	1	
Ecchinococcus cyst	Ulcer	1	
Abscess	Cancer (not located)	1	
Gumma	Abdominal tumor	1	
Ruptured	Gastric ulcer	1	10
Hernias			
Rt. inguinal	Adhesions	2	
Rt. inguinal	Gastric ulcer	1	
Lt. inguinal	Gastric ulcer or malignancy	1	
Lt. inguinal	None	1	
Epigastric	Gallstones	1	6
Pancreas, cancer	Cancer of the pancreas	1	
Pancreas, cancer	Malignancy (not located)	3	
Pancreas, cancer	Obstructive jaundice	1	5
Renal			
Perinephritic abscess	Perinephritis	1	
Pyonephrosis and gallstones	Gastric ulcer	1	
Cancer	Neoplasm near cecum	1	3
Miscellaneous			
Peritoneal lymphoma	Abdominal tumor	1	
Peritoneal lymphoma	T.b. peritonitis	1	
Lane's kink	Intestinal obstruction	1	
Abdominal cyst	None	1	
Adhesions	Partial obstruction	1	
T.b. peritonitis	Diverticulitis	1	
Retrocecal abscess	Abdominal tumor	1	
Cancer, bladder, metas. to sacrum	Malignancy (not located)	1	
Cancer of pelvis origin unknown	Obstruction	1	
General carcinomatosis	T.b. or cancer of colon	1	
Hemorrhoids, internal	Malignancy (not located)	1	
Hemorrhoids, internal	Gastric pathology	1	
Hemorrhoids, internal	None	1	
Subphrenic abscess	Appendicial abscess	1	14
Gastrointestinal	See Table 1	11	
		117	

Of the cases not explored it was found difficult to follow those from the outpatient department to any definite conclusion. The house cases present an interesting variety of conditions. The final clinical diagnoses of 564 cases followed in the records to their conclusion are given in Table III.

The roentgen findings in the gastrointestinal tract were confirmed in nearly all of these. In the cases of colitis, clinical and laboratory evidence is sufficient for diagnosis and roentgen evidence may be negative unless the condition in the bowel is very marked. As for the 7 diagnosed clinically as peptic ulcer, considering the average percentage of roentgen findings, probably most of them were not ulcers. If no roentgen examination had been made the probability of correct clinical diagnosis would give us 4 or 5 ulcers. As this report deals with gastrointestinal examination only, it is needless to say that most of the diagnoses of diseases of the bones, heart and great vessels, lungs and mediastinum, pleura, kidneys and many of the gall-bladder were made or confirmed by appropriate roentgen examinations of these parts.

PTOSIS

An interesting class in which no pathological lesion was found has been considered separately because of the apparent relation of the symptoms and roentgen findings, and classified as ptosis. The history often suggests organic disease and many are sent to us with a provisional diagnosis of ulcer or cancer. In 551 cases of ptosis 28.5 per cent were diagnosed as probable ulcer and 8 per cent as malig-

TABLE III

Arteriosclerosis	24	Gastritis, acute	2	Pancreatitis, acute	3
Arthritis	13	Gastritis chronic alcoholic	1	Psychosis	1
Addison's disease	6	General septicemia	1	Psoas abscess	1
Anemia, secondary	6	Hypochondriasis	7	Pneumophagia	1
Anemia, splenic	1	Hernia, inguinal	6	Pneumonia	1
Aortic disease	5	Hyperchlohydria	9	Pregnancy	1
Angina pectoris	4	Hypertension	6	Polycythemia	1
Asthma	3	Hysteria	4	Polyglandular disease	1
Adhesions	1	Hyperthyroidism	2	Retinal hemorrhage	1
Abdominal pain	1	Hemorrhoids, internal	1	Renal	
Achylia gastrica	1	Hyp. pulm. osteoarthrop.	1	Chronic nephritis	10
Anal fistula	1	Intestinal obstruction	5	Stone	5
Amenorrhea	1	Intestinal hemorrhage	1	Malignant	2
Back strain	2	Intestinal indigestion	1	Ptosis	2
Banti's disease	2	Impacted feces	1	Pyonephrosis	2
Bartholini's abscess	1	Jaundice, catarrhal	6	Pyelitis	1
Constipation	21	Jaundice, toxic	4	Hydronephrosis	1
Cardiac disease	19	Jaundice, hemolytic	2	Perinephritic abscess	1
Colitis	9	Jaundice, obstructive	1	Perinephritic tumor	1
Cancer		Liver		Syphilis	39
Abdominal	1	Cirrhosis	9	Sacroiliac disease	2
Breast	1	Cancer	7	Salpingitis	2
Colon	1	Ac. yellow atrophy	2	Spinal caries	1
Gall-bladder	5	Gumma	2	Spinal dislocation	1
Lung	5	Sarcoma	1	Spasm	2
Mediastinum	1	Cyst	1	Tuberculosis	
Neck	1	Abscess	1	Lung	22
Pancreas	5	Leucemia, myeloid	1	Spine	3
Prostate	3	Labyrinthitis	1	Abdominal	2
Pleura	1	No disease	16	Ulcer, peptic	7
Stomach	1	Neurosis	10	Uterine	
Uterus	1	Neurasthenia	5	Laceration	1
Vagina	1	Osteoma of sacrum	1	Anteflexion	1
Diarrhea	6	Otitis med. chron	1	Polyp	1
Diabetes	2	Obesity	2	Fibroid	1
Dysmenorrhea	3	Oedema	1	Prolapse	1
Dysentery	1	Orchitis	1	Vomiting, postinfluenzal	1
Epilepsy	12	Psychoneurosis	41	Vomiting, recurrent	1
Endometritis	9	Pernicious anemia	20	Vertigo	1
Exhaustion	2	Ptosis	18		
Gall-bladder disease	39	Pleuritis	5		564
Glandular insufficiency	2	Poisoning, lead and morphia	8		
Glaucoma, acute	1				

nant. All had gastric symptoms of considerable duration and intensity, with definite disability. As low position is often coincident with ulcer it is obvious that such cases should receive most careful examination. An appreciable residue was found in 15 per cent of these cases. Analysis as to age and sex shows; 20 to 30, 41 per cent; 30 to 40, 23.9 per cent; 40 to 50, 22.5 per cent; over 50, 12.6 per cent. Female, 83 per cent; male, 17 per cent. Of these cases 15 were explored. No gastrointestinal disease was found. In 8, pathology was found in other organs.

DUODENAL ULCER

The most frequent lesion found was duodenal ulcer; 617 being diagnosed as such. Of these, 139 were explored. In 129, or 92 per cent the diagnosis was confirmed and in 10 the following conditions were reported by the surgeon. Cancer of the pancreas, 2; cholecystitis with adhesions to the duodenum, 1; appendicitis, 3; no pathology found, 4.

A comparison of the clinical and operative diagnoses in these 10 cases is as given in Table IV.

In 7 of these cases the mistake made roentgenologically was to diagnose ulcer when no important lesion (not counting "chronic appendicitis" as such) was found. Spasm probably misled us if we concede the correctness of the surgical report in all cases. In 2 of the appendectomies the records show operation through a McBurney incision without exploration of the duodenum.

The clinical diagnoses in the cases of duodenal ulcer confirmed at operation are shown in Table V.

TABLE IV

Clinical	Operative	
Gastric cancer	Cancer of the pancreas	1
Malignancy (not located)	Cancer of the pancreas	1
Gastric cancer	No pathology found	1
Gastric ulcer	No pathology found	1
None "for study"	No pathology found	1
None "for study"	No pathology found	1
Duodenal ulcer	Acute cholecystitis with adhesions	1
Duodenal ulcer	Appendix	1
Duodenal ulcer	Appendix	1
Duodenal ulcer	Appendix	1
		10

TABLE V

None	26	Ptosis or ulcer	1
Gastric ulcer	24	Adhesions or gall-bladder	1
Duodenal ulcer	23	Chronic appendix	1
Ulcer (not specified)	17	Gastric tumor	1
Pyloric ulcer	8	Cardiospasm	1
Malignancy (not located)	5	Pyloric stenosis	1
Gastric cancer	4	Gallstones	1
Cancer or ulcer	3	Gall-bladder disease	1
Adhesions	2	Gastric stasis	1
Adhesions or gallstones	2	Pyloric neoplasm	1
Hyperacidity	2	Hypersecretion	1
Ulcer or appendix	1	Indefinite	1
			129

TABLE VI

	Total cases	Explored	Correctly Diagnosed	Pathology Correctly Located	Pathology Missed or Incorrectly Located	Pathology Diagnosed, None Found	Per Cent Correct Diagnoses	Per Cent Correctly Located
Negative G-I tract	2176	117	106	...	11	0	0.906	
Duodenal ulcer	617	139	129	129	6	4	0.928	
Ptosis	551	15	15	...	0	0	1.000	
Appendicitis	372	35	34	34	1	1	0.971	
Adhesions	271	51	47	51	0	0	0.921	1.000
Gastric cancer	245	97	95	96	1	0	0.980	0.990
Gastric ulcer	173	71	66	68	3	0	0.930	0.957
Gall-bladder disease	171	34	32	32	2	0	0.940	
Postoperative cases	149	23	23	23	0	0	1.000	
Miscellaneous abdominal	137	75	58	73	2	0	0.773	0.973
Esophageal	127	127	127	127	0	0	1.000	
Pyloric obstruction	57	32	32	32	0	0	1.000	
Benign gastric tumors	2	2	2	2	0	0	1.000	
Total	5049	818	766	667	26	5	0.936	0.963

The only pathognomonic sign of duodenal ulcer is a characteristic deformity of the bulb. Other signs are suggestive but any of them, including deformities, may be counterfeited by the effects of reflex irritation or spasm from acute inflammatory conditions elsewhere in the abdomen or pathology in adjacent organs with adhesions, and very careful observation and experience are often necessary to differentiate.

APPENDICITIS

Pathology in the appendix was diagnosed in 372 cases. Record was found of 35 operations; 34 were confirmed. In one no pathology was found.

The findings suggesting the diagnosis were: Appendix visible and locally tender; tenderness following the position of appendix if movable; limited mobility or fixation; abnormal position; irregularities of shape; residue after the cecum was empty; evidence of gastric irritability with no evidence of gastric or duodenal lesion.

None of these findings is pathognomonic. The first, or a combination of the first and last seems most significant and was noted in 70 per cent of the cases.

A gastric residue was noted in 8 per cent of these cases suggesting pyloric spasm although the residue was less as a rule than the delay due to gastric lesions.

A clinical diagnosis of appendicitis was made in 14 of these cases. Ulcer was suggested in 10. No diagnosis was suggested in 6. Gall-bladder disease, ptosis, obstruction in the colon and diverticulitis in one each.

ADHESIONS

Next in numerical importance is the class diagnosed as probable adhesions involving various parts of the tract. Of these, 271 were found; 51 came to operation; 47 were confirmed by the surgeon. Three were diagnosed surgically as chronic appendicitis. In one an ulcer was found on the lesser curvature of the stomach.

GASTRIC CANCER

Cancer of the stomach was diagnosed in 245 cases; 97 were operated upon; 95 were confirmed. In one the exploration revealed an extensive obstructing cicatrix learned to be the result of swallowing acid, no history of which was obtained before the roentgen examination. In the other an aneurysm of the abdominal aorta was found. Clinically a diagnosis of gastric cancer was made in 37 of these cases and a diagnosis of "malignancy" not located was suggested in 17 more. The average age of patients in this class was 54.7 years. The average duration of symptoms was nine months.

SYPHILIS OF THE STOMACH

Syphilitic changes in the stomach have often been suspected, but positive evidence is difficult to obtain. A careful study has been made of all cases in this series clinically syphilitic and 6 were found which at operation were suggestive. These were all followed up. In 4, microscopic examination of sections showed cancer. One patient from whom no tissue was removed for examination died within the year with all clinical evidences of malignancy. Tissue from one in whom a partial gastrectomy was done was reported pathologically as not cancer, but possibly tuberculosis or syphilis; no organisms were found. This patient has disappeared and cannot be traced by our social service department. These cases have all been included in the class of gastric cancer.

We are now making a study of all the cases in the history of our roentgen department which might be syphilitic and hope to find more evidence of this condition.[1]

GASTRIC ULCER

One hundred seventy-three cases were diagnosed as gastric ulcer. Of these, 71 were explored; 66 were confirmed. Two were reported by the surgeon as adhesions between the stomach and gall-bladder and liver with the origin of the inflammatory process not located. One each was reported as gynecological inflammation, appendicitis and cholecystitis. In the last 3, assuming the absence of lesion in the stomach, the gastric abnormalities observed were probably from reflex spasm and consisted of hyperperistalsis, increased emptying time, and incisura-like contractions. In all 5 the provisional clinical diagnosis was probable gastric ulcer.

In the 66 cases confirmed at operation the diagnosis of peptic ulcer was made clinically in 29, and in 7 more the clinical diagnosis was between ulcer and cancer.

The average age of these patients was forty-seven years. The average duration of symptoms was five years.

[1] Merrill, A. S. Syphilis of the stomach, with a study of ten probable cases. Am. J. Roentgenol. & Rad. Therapy, 1924, xii, 444–453.

GALL-BLADDER DISEASE

One hundred seventy-one cases were diagnosed as probable gall-bladder disease largely on circumstantial evidence in the absence of suggestive findings in plates of the gall-bladder region. Of these, 34 were explored; 32 were confirmed. In one a duodenal ulcer was found and in one a liver abscess.

PYLORIC OBSTRUCTION

A small class of cases presenting definite evidence of a local lesion of limited area causing almost complete obstruction at the pylorus was diagnosed as "obstructive lesion at the pylorus." Of cases so diagnosed, 57 in number, 32 were operated upon. Obstruction was confirmed in all cases. Eight were reported as malignant and 24 as ulcer. In those cases where resection was done the final diagnosis often awaited the report of the pathologist. In considering the difficulties attending the correct pathological diagnosis of these cases by roentgen-ray and clinical evidence, it is interesting to note that in the 8 malignant cases the average age was fifty-one, the youngest thirty-four and the oldest seventy-five. The average duration of symptoms was 2.5 years. In the 24 cases reported as ulcer the average age was fifty-four, the youngest twenty-five and the oldest sixty-nine. The average duration of symptoms was 5.5 years.

ESOPHAGEAL LESIONS

During this period 127 examinations of the esophagus alone were made. The roentgen findings were all confirmed by esophagoscopy as follows; Cancer 56; benign stricture 15; cardiospasm 12; diverticulum 6; negative 35; laceration by foreign body 2; broncho-esophageal fistula 2. One case presented both spasm or stricture at the cardia and a diverticulum in the upper portion.

MISCELLANEOUS INTESTINAL AND ABDOMINAL CONDITIONS

In the tract below the duodenum only lesions causing a marked change in the lumen of the bowel can be diagnosed with any degree of certainty. In the jejunum and ileum owing to the normal irregularity of the barium shadows a lesion must cause more or less degree of obstruction to be located. Indirect signs as displacements, limitations of mobility, hyperactivity, hypermotility, hypomotility, gas formation, etc. may be suggestive of pathology. The large bowel with its characteristic outline and slow movements is easier to study, but the presence of fecal material or gas, and difficulties in filling due to irritability and spasm cause many errors and one observation is often inconclusive.

The following is an attempt at classifying 137 miscellaneous intestinal and abdominal cases.

Of 20 cases involving the small bowel, 9 were operated upon and confirmed. The clinical diagnosis was essentially correct in 5 of these.

Abnormalities of the cecum were diagnosed by roentgen examination in 20 cases. Fourteen of these were operated upon. In all of them abnormalities of the physical nature described were found but in several cases the correct pathology was not recognized. In 4 cases the examiner reported simply "pathological cecum." One of these was found to be cancer; one, tuberculosis; one, pericecal adhesions from salpingitis; one, cecum adherent to pathological gall-gladder. In another, cancer was diagnosed when tuberculosis was found. In one a supposed cancer was found to be actinomycosis. Another diagnosed as "pathology in the right lower quadrant of unknown nature" was pericecal adhesions from salpingitis. The provisional clinical diagnosis was essentially correct in 7 cases.

Between the cecum and the sigmoid abnormalities were diagnosed in 41 cases. Of these, 9 were operated upon and the diagnosis confirmed in all cases. The provisional clinical diagnosis was correct in 2 cases.

Thirty-three cases of pathology in the sigmoid and rectum were reported by roentgen examination and 29 of them were operated upon. In 27 the diagnosis was confirmed. In one a cancer of the rectum was called "stricture," and in one a cancer

of the sigmoid was diagnosed as "abdominal tumor." The provisional clinical diagnosis was correct or approximately so in 18 cases.

Of 13 cases where disease of the peritoneum was suspected without involvement of the lumen of the intestinal tract 4 were operated upon. The roentgen suspicion was correct in two. In one case of cancer of the mesentery and one of tuberculous peritonitis nothing was found by roentgen examination. The clinical suspicion was correct in one case.

Four cases of pathology of the liver were met in this series. All were explored. In 3 the roentgen-ray prediction was confirmed. In one the roentgen diagnosis was "pathological liver," and sarcoma was found. In the last the clinical diagnosis was cancer of the liver. In one, cancer of the liver was diagnosed correctly clinically and in two others the clinical diagnosis was "cancer, not located."

Disease of the pancreas was found in 3 cases. In one the roentgen suspicion was diffuse abdominal malignancy which was found originating in the pancreas. In one duodenal obstruction was found by the roentgen ray, and was found surgically to be caused by a tumor of the head of the pancreas. In another the roentgen report was abdominal tumor deforming the stomach by pressure and a large pancreatic cyst was found. None of these was correctly diagnosed clinically.

Three others were diagnosed by the roentgen ray as abdominal tumor of unknown nature. Two were explored and retroperitoneal tumors were found. One was not explored. Neither of the operated cases was diagnosed clinically.

POSTOPERATIVE EXAMINATIONS

One hundred forty-nine cases were reexamined after operation and 23 of these were reoperated. The roentgen findings were confirmed in all cases. Nine gastrojejunal ulcers were found; 4 cases of vicious circle; 3 of adhesions involving the stomach; 2 of stoma closed by adhesions; 2 of recurrent gastric ulcer; 2 recurrent gastric cancers and one recurrent duodenal ulcer.

BENIGN GASTRIC TUMORS

During the course of these examinations two interesting cases of benign tumor of the stomach were observed and correctly diagnosed.

Classifying these cases by their roentgen findings in order of their relative frequency they appear in Table VI.

SUMMARY AND CONCLUSIONS

1. Our proven error in 818 cases explored is approximately 4 per cent. Our positive error, i.e., diagnosis of disease where none was found at operation was 1.2 per cent.

2. Of 2176 cases roentgenologically negative only 117 were explored. This may indicate confidence in the roentgen findings on the part of the consultant, conservatism of the patient or mildness of symptoms.

3. No gastric ulcer nor cancer found at operation was missed by the roentgen ray. Two duodenal ulcers were missed.

4. In a certain number of cases of gall-bladder disease the observer was content to report a negative gastrointestinal tract, either overlooking or not recording the suggestive signs of gall-bladder disease. More attention is now being paid to these signs. The cases of disease of the colon missed illustrate the importance of following the routine examination by examination of the colon with opaque enema in questionable cases.

5. In 551 cases showing roentgenologically ptosis only, a clinical diagnosis of peptic ulcer had been made in 28 per cent and a diagnosis of cancer in 8 per cent. Presumably the gastric symptoms in these cases are due to reflex causes with or without hyperacidity. Yet ptosis and ulcer coexist in many cases.

6. In duodenal ulcer the roentgen findings were confirmed in 92 per cent of the cases. Only 22 per cent of the cases of duodenal ulcer came to operation so far as we know, suggesting milder symptoms as compared with gastric ulcer, 40 per cent of which were known to have been operated upon.

7. Only about one-half the duodenal ulcers correctly diagnosed by the roentgen ray had been recognized clinically.

8. Reflex irritation or spasm may cause any of the abnormalities upon which the diagnosis of duodenal ulcer is based and is the most frequent cause of error.

9. In gastric ulcer our findings were confirmed in 93 per cent. The correct clinical diagnosis was made in 56 per cent.

10. In gastric cancer our results were correct in 95 out of 97 cases operated upon, and one of the two errors could have been avoided if a history of swallowing of corrosive had not been withheld. The clinical diagnosis was right or nearly so in 55 cases.

11. Pyloric obstruction was correctly diagnosed in all of 32 cases operated upon. Even at operation it was often impossible to make further pathological diagnosis.

12. Disease of the appendix was indicated by the roentgen ray in 372 cases. As only 35 of these are known to have been operated upon we may suspect that the disease was rarely acute. Out of 35 cases our diagnosis was confirmed in 34. Fourteen of these had been diagnosed clinically. There are no pathognomonic roentgen signs, and the conditions most frequently confusing the diagnosis are gall-bladder disease and gynecological pathology.

13. In 34 explored cases of gall-bladder disease, out of 171 cases so suggested by the roentgen ray, our diagnosis was confirmed in 32.

14. The roentgen diagnosis in esophageal conditions was confirmed in all cases by esophagoscopic examination or operation. Clinically 18 of the 70 cases of obstruction were not recognized. Cardiospasm, 13 cases, and diverticulum, 6 cases were not diagnosed as such clinically. The usual diagnosis was obstruction. The former has been proven by Mosher to be often stricture in the liver tunnel and not spasm. On the other hand, in 24 of 35 cases roentgenologically negative, a clinical diagnosis of esophageal obstruction had been made.

15. No proven case of gastric syphilis came to light in this series.

16. Forty-seven out of 51 cases diagnosed as adhesions were confirmed at operation.

17. Diseases of the small intestine unaccompanied by definite changes in the lumen or obstruction have few or no signs.

18. The large bowel should be examined by enema after thorough cleaning out, and even then pathology that does not affect the lumen to some extent may be overlooked.

REPORT OF 1326 ROENTGEN EXAMINATIONS FOR SUSPECTED URINARY CALCULI

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THERE were examined in the Roentgen Department of the University Hospital for suspected urinary calculi 1326 cases, between March 1, 1916 and March 1, 1925.

The most significant fact brought out by an analysis of the data is the unusually large number of negative findings in patients referred for examination because of symptoms suggesting the presence of renal calculi. These patients constituted 83.96 per cent, or a total of 1113. It seems quite certain that an etiological factor other than urinary calculi must have been present in a large number of these cases to account for the negative findings. A study of the roentgenograms reveals in a large number of patients evidence of the presence of a more or less advanced form of hypertrophic arthritis of the spine, and in the absence of any other causative agent, it is not unreasonable to assume that this spinal condition may have been the underlying factor.

The percentage of the positive findings was 16.04, or a total of 213, male patients outnumbering female two to one. The average age of the males was forty-one, that of the females thirty-nine. The oldest patient with a renal calculus was a man eighty-one years of age, the youngest was a boy of twelve.

A more detailed analysis of the data shows the right side to be more frequently implicated than the left, a total of 108 calculi being found on the right as against 85 on the left side. The distribution was as follows:

Right kidney	57	Left kidney	45
Right pelvis	13	Left pelvis	5
Right ureter	38	Left ureter	35

The kidney substance and the pelvis were the chief sites of election, the two ureters being affected about equally.

In all, there were 6 cases of migratory calculi. The majority had moved downward to the bladder; only one had migrated to the kidney pelvis from its previous position in the ureter. As the patient in this case had no previous ureteral catheterization, the stone had probably been carried upward by reversed peristalsis.

Forty-seven patients examined had multiple calculi, these were about equally distributed on the two sides. One patient had a large calculus in the bladder besides one in the prostatic and one in the penile portion of the urethra. All three stones were successfully removed.

Of the interesting types may be mentioned; a complete calcification of the left kidney; a "stag-horn" calculus filling all the calyces, a "hammer-shaped" stone filling the left pelvis with the "handle" fitting snugly in the first portion of the ureter, and a degenerated kidney with the capsule containing a myriad of stones all of the same shape, but ranging in size from that of a grain of sand to 2 cm. in diameter. Vesical calculi were found in 18 patients; in very few were they multiple, and in only 2 were they found to merit the title "goose egg." The size of the majority of renal calculi was less than 1 cm. in diameter.

It is routine practice to advise a pyelographic examination in order to check up all suspicious shadows, and in a number of instances we have been able to rule out shadows caused by calcified mesenteric glands and other extraneous substances lying in the course of the ureter, or overlying the kidney. There has been no difficulty in differentiating phleboliths from true ureteral calculi.

Pyelograms have the added advantage of revealing a number of pathological conditions in the kidneys, pelves and ureters otherwise impossible of detection. A number of patients with urinary calculi also had hydronephrosis on the same side to varying degrees. Hydronephroses were found to be far more common on the

right than on the left side—the proportion being two to one. There was no appreciable difference between the sexes, barring those incident to pregnancy. As regards the latter type of hydronephrosis, pyelograms made before and after the termination of pregnancy showed that with the relief of high intra-abdominal tension the hydronephrosis, usually present on the right side, disappeared gradually and the pelvis and ureter assumed their normal size and position.

Very rarely gallstone attacks simulate renal colic. Three patients referred for suspected urinary calculi showed no evidence of the presence of any shadows within the urinary system, but revealed definitely enlarged gall-bladders with characteristic shadows of one or more gallstones.

Diverticula of the bladder were rather uncommon. In addition to the use of opaque catheters introduced into the diverticulum, contrast cystograms were employed to advantage. Diverticula were single in the majority of the cases, and were found usually on the right side of the bladder.

Instances of prolapsus of the kidney, cystic kidney, tuberculous kidney and tumors of the kidney (principally hypernephromas) were encountered.

Kinking of the ureter was found less often to be the etiological factor in the production of hydronephrosis and hydroureter than stricture of the ureter. The latter was, moreover, associated with ureteral calculi in a number of cases. Pyelograms made after the passage or removal of the calculus and correction of the stricture showed both pelvis and ureter free from dilatation. The pelvis and ureter of one patient held 99 c.c. of the opaque solution before the removal of a calculus in the lower end of the ureter. A month later the capacity had been reduced to 35 c.c.

SUMMARY

1. Of 1326 roentgen examinations for suspected urinary calculi, only 16.04 per cent showed positive shadows.

2. Hypertrophic arthritis of the spine gives rise to symptoms simulating those occasioned by urinary calculi.

3. The proportion of positive findings in male and female patients was two to one.

4. Calculi were more frequent on the right side.

5. Pyelograms showed hydronephrosis and hydroureter to be far more common on the right side.

6. Gallstone attacks may simulate renal colic.

7. The size of the majority of calculi was small, being less than 1 cm. in diameter.

ROENTGEN-RAY THERAPY IN BRONCHIAL ASTHMA

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BECAUSE a very appreciable number of asthmatics fail to respond to the usual form of therapy, many other methods, largely empiric, have been tried. The encouraging reports of the use of roentgen therapy in asthma by Immelmann,[1] Eckstein,[2] Gottschalk,[3] Klewitz,[4] and others, led to its trial by us.

Theoretically, roentgen rays should prove a rather alluring method of therapy. Their possible destructive effect on the lymphatic channels of the lungs which must play a rather prominent part in bacterial asthma, must be considered. However, it is possible that the effect is on the hydrogen ion concentration of the bronchial cells, or a change in the colloids of the blood as a whole.

With these possibilities in mind, we treated a series of 35 cases, which had not responded to the usual forms of treatment, with roentgen rays.

The following technique was employed: 200,000 volts, 6–8 ma., at a distance of 50 cm., through 0.75 mm. copper.

Our results in 25 of the total number of 35 patients were entirely negative; 5 were temporarily improved, and only 5 showed a definite improvement continuing for a period of six months or longer.

CASE REPORTS

Case I. J. H., aged eighteen, asthma and autumnal hay fever for past ten years. Family history, brother has similar symptoms. Previous history, tonsils removed five years ago; had pneumonia four years ago. Tests, strongly positive to horse dandruff. Roentgen examination of chest shows marked enlargement of hilus lymphatics, increase in peribronchial fibrous tissue and involvement of the parenchyma left upper lobe (probably tuberculous). Sputum examination negative for tubercle bacilli. On culture, growths of *Micrococcus catarrhalis* and *Staphylococcus albus* were obtained.

Roentgen-ray Treatment. Dec. 23, 1922, left chest straight, 20 min.; Dec. 26, left chest straight, 20 min.; Dec. 27, right posterior axilla, 20 min.; Dec. 28, left posterior axilla, 20 min.; Feb. 24, 1923, left chest, 20 min.; March 8, left chest posterior, 20 min.; March 10, right chest anterior, 20 min.; March 12, right chest anterior, 20 min.; May 14, right chest anterior, 20 min.; May 21, right chest posterior, 20 min.; June 20, left chest anterior, 20 min.; June 22, right chest anterior, 20 min.; June 25, left chest posterior, 20 min.; June 28, right chest posterior, 20 min.

Result. Improvement in symptoms following each series of roentgen treatments. Improvement lasted for three or four weeks, followed by a return of symptoms.

Case II. R. H., aged three, asthma for past two years. Family history, negative. Tests, negative throughout. Roentgen examination of chest shows slight increase in hilus lymphatics. No peribronchial thickening.

Roentgen-ray Treatment. Apr. 20, 1923, chest anterior, 10 min.; Apr. 21, chest posterior, 10 min.; Sept. 5, chest anterior, 10 min.; Sept. 6, chest posterior, 10 min.

Result. No improvement in patient's symptoms.

Case III. M. H., aged thirty-eight, asthma for several years. Sputum negative for tubercle bacilli. Wassermann reaction negative. Roentgen examination of chest shows moderate amount of emphysema, increased hilus lymphatics and peribronchial thickening. Protein test shows slightly positive reaction to horse dandruff, goose feathers, dog hair, timothy, ragweed. Strongly positive to several foods.

Roentgen-ray Treatment. May 3, 1923, left chest anterior, 25 min.; May 4, right chest anterior, 25 min.; May 7, left chest posterior, 25 min.; May 8, right chest posterior, 25 min.; Oct. 19, spleen anterior, 10 min.; Oct. 26, spleen posterior, 10 min.

Result. No influence on patient's symptoms.

Case IV. V. G., aged thirty-one, asthma for past four years. Sputum negative for tubercle bacilli. Wassermann reaction, negative. Protein test, positive to turkey and ragweed.

Roentgen-ray Treatment. May 4, 1923, right chest anterior, 25 min.; May 14, left chest anterior, 25 min.; May 16, left chest posterior, 25 min.; May 18, right chest posterior, 25 min.

Result. No improvement in patient's symptoms.

Case v. A. F., aged seventeen, asthma on and off since seven years of age. Family history, negative. Previous history, negative. Tests, reacted positively to potato, rice, goose feathers, rabbit hair, and silk.

Roentgen-ray Treatment. Oct. 22, 1923, spleen anterior, 10 min.; Oct. 24, chest anterior, 25 min.; Oct. 25, chest posterior, 25 min.; Oct. 26, spleen posterior, 10 min.

Result. Patient has definitely improved though has an occasional attack.

Case vi. A. C., aged sixty, asthma for past six years. Family history, negative. Wassermann reaction, negative; urine negative; sputum negative for tubercle bacilli; protein test negative throughout; roentgen examination of sinuses negative; roentgen examination of lungs negative for tuberculosis. Moderate increase in peribronchial thickening and in hilus lymphatics.

Roentgen-ray Treatment. Oct. 5, 1922, chest anterior, 30 min.; Oct. 10, chest posterior, 20 min.

Result. No improvement in patient's symptoms.

Case vii. L. F., aged eighteen, asthma for several years. Family history, negative. Wassermann reaction, negative; sputum negative for tubercle bacilli; roentgen examination of sinuses negative; roentgen examination of chest shows lungs markedly emphysematous. Marked amount of thickening around both roots. Definite area of dense involvement left upper lobe. Protein test, positive to beef and rabbit hair; very strongly positive to horse serum.

Roentgen-ray Treatment. Oct. 23, right breast anterior, 60 min.; Oct. 25, right posterior axilla, 15 min.; Oct. 27, right posterior axilla, 15 min.; Oct. 30, left posterior axilla, 20 min. Nov. 20, right posterior axilla, 20 min.; Dec. 4, right posterior axilla, 30 min.; Dec. 5, left posterior axilla, 30 min.; Dec. 6, right chest straight, 20 min.; Dec. 7, left chest straight, 20 min.

Result. There was a definite temporary improvement following each series of treatment.

Case viii. H. F., aged forty-five, asthma for about ten years. Sputum examination, negative for tubercle bacilli. Blood chemistry, normal. Wassermann reaction negative. Protein test negative throughout.

Roentgen-ray Treatment. Apr. 30, 1923, right chest anterior, 25 min.; May 1, left chest anterior, 25 min.; May 2, left chest posterior, 25 min.; May 3, right chest posterior, 25 min.

Result. No improvement in patient's symptoms.

Case ix. N. F., aged twenty-eight, asthma for past two years. Family history, father has chronic bronchitis. Sputum examination negative for tubercle bacilli. Wassermann reaction negative. Urine negative. Protein test negative throughout.

Roentgen-ray Treatment. May 4, 1923, right chest anterior, 25 min.; May 7, left chest anterior, 25 min.; May 8, left chest posterior, 25 min.; May 9, right chest posterior, 25 min.

Result. No change in patient's symptoms.

Case x. F. H., aged seventeen, asthma for past two years. Family history, negative. Tests, positive to cocoa and horse dandruff; sputum examination negative for tubercle bacilli. Roentgen examination of chest negative for tuberculosis. Shows increased peribronchial thickening and increase in hilus lymphatics.

Roentgen-ray Treatment. Jan. 5, 1923, right chest straight, 20 min.

Result. No improvement in patient's symptoms.

Case xi. L. B., aged fifty-four, asthma for past seven years. Family history, father had asthma. Wassermann reaction negative. Protein test, negative throughout.

Roentgen-ray Treatment. June 11, 1923, right chest anterior, 20 min.; June 12, left chest anterior, 25 min.; June 13, left chest posterior, 25 min.; June 14, right chest posterior, 25 min.

Result. No change in patient's symptoms.

Case xii. M. L., aged five, asthma and hay fever for past two or three years. Family history, aunt has asthma and hay fever. Roentgen examination of chest shows slight increase in peribronchial lymph nodes. Protein test, positive reaction to carrot, cocoa, halibut, rice, rye, horse dandruff, goose feathers, cattle hair, red top, wild carrot and ragweed.

Roentgen-ray Treatment. Oct. 15, 1923, left chest anterior, 10 min.; Oct. 16, right chest anterior, 9 min.; Oct. 17, chest posterior, 10 min.; Oct. 18, spleen anterior, 6 min.

Result. The patient improved definitely following the treatments and improvement has continued.

Comment. All positive proteins were eliminated and the patient was being inoculated against the various epidermals and injected with a mixed vaccine.

Case xiii. S. M., aged forty-three, asthma for past four years. Family history, negative. Previous history, negative. Basal metabolic

rate, minus 34 per cent; urine negative; Wassermann reaction, negative. Stool, marked albumin putrefaction. Protein test, negative throughout. Roentgen examination of chest shows increased peribronchial thickening and increase in hilus lymphatics.

Roentgen-ray Treatment. Oct. 17, 1923, spleen, 10 min.; Oct. 18, chest anterior, 25 min.; Oct. 19, chest posterior, 25 min.; Oct. 20, spleen, 10 min.

Result. No change in patient's symptoms.

Case XIV. A. M., aged fifty-three, asthma for past five or six years. Family history, negative. Roentgen examination of chest, negative for tuberculosis. Shows moderate increase in peribronchial fibrosis and hilus lymphatics.

Roentgen-ray Treatment. Oct. 3, 1923, right chest anterior, 25 min.; Oct. 4, left chest anterior, 27 min.; Oct. 5, right chest posterior, 25 min.; Oct. 16, spleen, 10 min.

Result. No change in patient's symptoms.

Case XV. A. M., aged fifty, asthma for several years. Family history, negative. Blood chemistry, normal. Basal metabolic rate, minus 8 per cent. Protein test, negative throughout.

Roentgen-ray Treatment. Apr. 5, 1923, right chest anterior, 20 min.; Apr. 6, left chest anterior, 20 min.

Result. No change in patient's symptoms.

Case XVI. R. E., aged seven, asthma on and off for past six years. Family history, negative. Protein test, positive to banana, rice and salmon. Sputum negative for tubercle bacilli. Roentgen examination of chest negative for tuberculosis. Marked increase in hilus lymphatics. Wassermann reaction, negative. Stool examination, marked increase in albumin putrefaction.

Roentgen-ray Treatment. Apr. 12, 1923, right chest anterior, 15 min.; Apr. 13, left chest anterior, 15 min.; Apr. 16, right chest posterior, 15 min.; Apr. 17, left chest posterior, 15 min.

Result. Patient has not had an attack since May, 1923, which is immediately following the roentgen treatments given as indicated above.

Case XVII. C. B., aged twenty-four, asthma for past three years. Family history, negative. Sputum examination, negative for tubercle bacilli. Roentgen examination of lungs negative for tuberculosis. Moderate increase in lymphatic element around both roots. Wassermann reaction, negative. Blood chemistry, normal except for high plasma chlorides. Protein test, positive to celery, rice, tea, and strongly positive to goose feathers.

Roentgen-ray Treatment. May 9, 1923, right chest anterior, 25 min.; May 10, left chest anterior, 25 min.; May 11, right chest posterior, 25 min.; May 14, left chest posterior, 25 min.

Result. Marked improvement for about seven months, then symptoms returned again.

Comment. When this patient was first examined, positive proteins were eliminated, but her symptoms, though relieved, did not disappear until after the roentgen-ray treatments.

Case XVIII. P. B., aged thirty-five, asthma for past year. Has chronic cough and expectoration. Family history, negative. Sputum negative for tubercle bacilli. Protein test negative throughout.

Roentgen-ray Treatment. July 3, 1923, right chest anterior, 25 min.; July 5, left chest anterior, 25 min.; July 16, left chest posterior, 25 min.; July 20, right chest posterior, 25 min.

Result. No change in patient's symptoms.

Case XIX. H. B., aged thirty-two, asthma for past fourteen years. Family history, negative. Sputum negative for tubercle bacilli. Stool examination, marked albumin putrefaction. Roentgen examination of lungs, negative for tuberculosis. No marked increase of lymphatics or peribronchial fibrosis. Protein test, positive to horse dandruff, goose feathers and cat hair.

Roentgen-ray Treatment. May 7, 1923, right chest anterior, 25 min.; May 8, left chest anterior, 25 min.; May 9, right chest posterior, 25 min.; May 10, left chest posterior, 25 min.

Result. No change in patient's symptoms.

Case XX. E. B., aged seventeen, asthma and hay fever for past two years. Hay fever of autumnal type. Family history negative. Sputum examination negative for tubercle bacilli. Protein test, positive to horse dandruff, rabbit hair and ragweed. Roentgen examination of lungs, negative or tuberculosis but shows increased peribronchial thickening and few very large lymph nodes at both roots of lungs.

Roentgen-ray Treatment. May 8, 1923, left chest anterior, 20 min.; May 9, 1923, right chest anterior, 25 min.; May 10, left chest posterior, 25 min.; May 11, right chest posterior, 25 min.

Result. Definite improvement in symptoms lasting for six to eight weeks, then symptoms returned.

Case XXI. A. B., aged twenty-nine, asthma for past eight months. Started with cough and profuse expectoration. Also itching of eyes

and sneezing. Family history negative. Previous history, severe attack of urticaria four years ago, tonsils and nasal polypi removed several years ago. Protein test negative. Sputum negative for tubercle bacilli. Urine shows marked increase of indican. Stool examination, moderate amount of albumin putrefaction. Roentgen examination of lungs shows increased peribronchial thickening and enlarged hilus lymphatics. Wassermann reaction negative.

Roentgen-ray Treatment. Sept. 28, 1922, chest anterior, 45 min.; Sept. 29, chest posterior, 45 min.

Result. No improvement in patient's symptoms.

Case XXII. F. W. Chronic cough and expectoration for past twenty years. No definite attacks of asthma. Family history negative. Tests, positive skin test to banana, bluefish, lettuce, oats, and slightly to horse dandruff and dog hair. Urine, negative. Sputum negative for tubercle bacilli. Wassermann reaction, negative. Blood chemistry, normal. Roentgen examination of chest shows enlargement of hilus lymphatics and increased peribronchial thickening. Sinuses show chronic sinusitis. Stool examination shows marked albumin putrefaction.

Roentgen-ray Treatment. Sept. 25, 1923, left chest anterior, 25 min.; Sept. 26, right chest anterior, 25 min.; Sept. 27, left chest posterior, 25 min.; Sept. 28, right chest posterior, 25 min.

Result. No improvement in patient's symptoms.

Case XXIII. A. W. Hay fever of the spring and autumnal type for the past ten years. Asthma during autumnal hay fever season. Chronic nasal catarrh all year around. Family history, sister has hay fever. No asthma in family. Tests, positive skin test to June grass, ragweed, goldenrod, and very strongly positive to horse dandruff. Examination of the nose shows membranes hypertrophied and edematous.

Roentgen-ray Treatment. Nov. 20, 1922, left chest straight, 30 min.; Nov. 27, nose, 10 min.; Nov. 28, right chest, 20 min.

Result. No influence whatsoever on patient's symptoms.

Case XXIV. L. W., aged twenty-eight, asthma on and off for several years. Hay fever autumnal type for several years. Family history, negative. Roentgen examination of sinuses shows chronic catarrhal sinusitis. Roentgen examination of chest shows moderate increase in hilus lymphatics; otherwise negative.

Roentgen-ray Treatment. Sept. 23, 1923, left chest anterior, 25 min.; Sept. 26, right chest anterior, 25 min.; Sept. 27, left chest posterior, 25 min.; Sept. 28, right chest posterior, 25 min.

Result. No appreciable change in patient's symptoms.

Case XXV. M. S., aged forty-nine, asthma for past twelve years; worse in summer. Family history, mother has asthma. Wassermann reaction negative. Blood chemistry, high plasma chlorides; otherwise negative. Urine, negative. Protein test, strongly positive to ragweed.

Roentgen-ray Treatment. May 28, 1923, right chest anterior, 25 min.; May 29, left chest anterior, 25 min.; June 8, left chest posterior, 25 min.; June 8, right chest posterior, 20 min.; Sept. 24, chest anterior, 25 min.; Sept. 26, chest posterior, 27 min.

Result. No change in patient's symptoms.

Remarks. This patient also has an advanced carcinoma of the uterus.

Case XXVI. S. S., asthma for past ten years. Family history negative. Examination of nose; septum deviated to the left; throat, tonsils large and infected. Heart negative. Tests, positive skin test to horse dandruff, goose feathers, rabbit hair, timothy, ragweed and several foods. Sputum negative for tubercle bacilli.

Roentgen-ray Treatment. Oct. 16, 1922, left chest anterior, 45 min.; Oct. 17, left posterior axilla, 60 min.; Oct. 18, right posterior axilla, 45 min.; Sept. 4, 1923, left chest anterior, 27 min.; Sept. 5, right chest, 25 min.; Sept. 6, left chest posterior, 25 min.; Sept. 7, right chest posterior, 25 min.

Results. Complete disappearance of symptoms following first series of treatments and freedom from symptoms continued for nearly a year when symptoms returned and another series of roentgen treatments were given; patient has been comparatively free from symptoms ever since.

Remarks. Before the first series of treatments were given, this patient received a series of injections against the proteins to which she reacted, with very little noticeable effect on the symptoms.

Case XXVII. L. S., asthma for about ten years. Attacks almost constant, day and night, characterized by cough, and difficulty in breathing. Examination of sputum, negative for tubercle bacilli. Wassermann reaction negative. Blood chemistry, normal. Roentgen examination of sinuses negative. Roentgen examination of

chest shows marked increase in hilus lymphatics and increased peribronchial fibrosis.

Roentgen-ray Treatment. Sept. 26, 1923, right chest anterior, 25 min.; Sept. 27, left chest anterior, 25 min.; Sept. 28, right chest posterior, 25 min.; Sept. 29, left chest posterior, 25 min.

Result. No change in patient's symptoms.

Case XXVIII. S. S., aged thirty-nine, asthma and hay fever for past ten years. Family history, mother has hay fever, sister has asthma. Tests, strongly positive reaction to horse dandruff, dog hair, goose feathers, timothy and ragweed. Blood chemistry, normal. Wassermann reaction negative. Stool, shows considerable albumin putrefaction and increase in fatty acids. Roentgen examination of sinuses shows chronic sinusitis. Throat, tonsils badly infected. Nose, deviation of septum high to the left; turbinates hypertrophied and edematous.

Roentgen-ray Treatment. Oct. 31, 1923, spleen anterior, 10 min.; Nov. 1, chest anterior, 25 min.; Nov. 2, chest posterior, 25 min.; Nov. 3, spleen posterior, 10 min.

Result. Definite improvement of symptoms lasting for about six weeks, then symptoms returned and have not been relieved.

Case XXIX. J. S., aged forty-two, asthma for past twenty-five years. Attacks usually accompanied by an acute cold and acute bronchitis; smokes considerably and his asthma gets worse when he attempts to stop smoking. Family history, negative. Sputum examination negative for tubercle bacilli. Culture shows *Streptococcus viridans*. Blood chemistry, high plasma chlorides; otherwise normal. Wassermann reaction, negative.

Roentgen-ray Treatment. May 18, 1923, right chest anterior, 25 min.; May 22, left chest anterior, 25 min.; May 23, left chest posterior, 25 min.

Result. No appreciable change in symptoms.

Case XXX. R. R., asthma on and off since sixteen years of age. Past three years symptoms have been nearly constant. Has chronic cough and expectoration. Family history, negative. Sputum negative for tubercle bacilli. Culture shows *Streptococcus viridans* and *Micrococcus catarrbalis*. Protein tests negative throughout. Roentgen examination of chest shows evidence of a chronic fibroid ptosis involving both upper lobes.

Roentgen-ray Treatment. Nov. 6, 1922, left breast straight, 30 min.; Nov. 9, right chest anterior, 30 min.; Jan. 20, 1923, left posterior axilla, 20 min.; Jan. 22, right posterior axilla, 20 min.

Result. No appreciable change in symptoms.

Case XXXI. M. R., aged fifty-eight, asthma for the past twenty years. Attacks worse in winter and has a chronic cough and expectoration. Family history negative for asthma, hay fever, etc. Blood chemistry negative. Wassermann reaction negative. Urine negative. Sputum negative for tubercle bacilli. Culture shows *Micrococcus catarrbalis*. Protein test negative throughout.

Roentgen-ray Treatment. May 25, 1923, right chest anterior, 25 min.; May 28, left chest anterior, 25 min.; May 29, left chest posterior, 25 min.; June 7, right chest posterior, 25 min.

Result. No apparent change in symptoms.

Case XXXII. J. R., aged fifty-five, asthma for the past fifteen years. Has a chronic cough and expectoration made worse on exposure to dampness and cold weather. Family history negative for asthma and hay fever. Previous history, negative. Tests, positive to bluefish, cantaloupe, corn, crab, slightly to wheat. Positive to horse dandruff, goose feathers, rabbit hair and ragweed. Urine, very faint trace of albumin, no casts. Wassermann reaction, negative. Blood chemistry, negative. Basal metabolic rate, minus 12 per cent; sputum negative for tubercle bacilli. Culture shows *Staphylococcus albus* and streptococci. Roentgen examination of sinuses negative. Roentgen examination of chest shows thickening around both roots and increase in peribronchial fibrosis. Aorta normal. The heart shows evidence of slight dilatation of the left auricle.

Roentgen-ray Treatment. Oct. 17, 1923, spleen, 10 min.; Oct. 18, chest anterior, 25 min.; Oct. 19, chest posterior, 25 min.; Oct. 20, spleen posterior, 10 min.

Result. No change in symptoms.

Case XXXIII. R. E., aged fifty, asthma almost every day for past six years. Family history, mother had asthma, sister has hay fever and daughter has hay fever. Protein tests, positive to goose feathers, clam, coffee, egg white, and lamb. Roentgen examination of chest shows considerable peribronchial thickening and increase in hilus lymphatics.

Roentgen-ray Treatment. Oct. 8, 1923, right chest anterior, 25 min.; Oct. 9, left chest anterior, 25 min.; Oct. 10, right chest posterior, 25 min.; Oct. 11, left chest posterior, 25 min.; Nov. 15, spleen anterior, 10 min.

Result. Definite improvement in symptoms beginning about two weeks after conclusion and persisting to date (three months later).

Case XXXIV. M. E., aged thirty-nine, asthma practically every day with short intervals of remission for past year. Family and previous history negative. Protein tests, positive to horse dandruff, rabbit hair and goose feathers. Roentgen examination of chest shows moderate increase in hilus lymphatics and increased peribronchial thickening.

Roentgen-ray Treatment. Sept. 25, 1923, right chest anterior, 25 min.; Sept. 26, left chest anterior, 25 min.; Sept. 27, right chest posterior, 25 min.; Sept. 28, left chest posterior, 25 min.

Result. No improvement.

Case XXXV. J. P., aged fifty-five, asthma for past five years. Attacks seem worse in spring and fall. Family history, negative for asthma, hay fever, etc. Sputum, negative for tubercle bacilli. Culture shows *Micrococcus catarrbalis* and *Streptococcus viridans*. Protein test, positive reaction to horse dandruff. Blood chemistry normal. Wassermann reaction, four plus.

Roentgen-ray Treatment. July 6, 1923, right chest anterior, 25 min.; July 9, left chest anterior, 25 min.; July 16, left chest posterior, 25 min.; July 18, right chest posterior, 25 min.

Result. No appreciable change in symptoms following treatment.

COMMENT

Though an analysis of the case records above cited would seem to indicate that roentgen-ray therapy offers no particular advantage over other methods of treatment in bronchial asthma, it appears to us that the definite effect noted in some of our cases would indicate that a modification of the present technique, or possibly a more careful selection of suitable cases may offer more encouraging results.

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THE EFFECT OF EXPOSURE TO ROENTGEN RAYS ON REPRODUCTION IN MALE RATS*

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IT is now well recognized that exposure of the body to roentgen rays or radium rays may result in partial or complete sterilization of the individual so exposed (Brown and Osgood, 1905). Although these radiations are noxious to the body in that they interfere with normal blood production (Mottram and Russ, 1921), the effect upon the reproductive glands is doubtless direct and specific. The accepted explanation of this outstanding fact is that the roentgen rays and the γ-rays of radium have a selectively destructive or inhibitive effect on the gonads so that this tissue becomes impotent to produce physiologically functional sex cells. This effect is selective only in the sense that the gonads are more sensitive than other tissues of the body, just as certain malignant or abnormal cells are more readily destroyed by this agent than are normal cells. There is abundant biological evidence that young, rapidly-dividing tissue cells are more susceptible than are cells which have reached functional maturity. The therapeutic application of radiation makes a broad assumption on this score and operators feel justified, with modern perfected technique, in attacking almost any pathological locus in the body. A similar margin of safety for

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other tissue cells may be assumed tentatively in radiation of the gonads.

If the latter assumption is correct, it should be possible to develop an unobjectionable method of sterilization. Further, it might be possible, since radiation sterility is not necessarily permanent, to develop a method by which reproduction could be effectively controlled without material interference with the other normal physiological mechanisms. This investigation represents an effort toward analysis of these possibilities, using the white rat as an experimental animal. Taking advantage of recent advances in our knowledge of the roentgen ray and the technique of its application, it was hoped to find not only the minimum effective dose to establish permanent sterility, but also the fractioned doses which would inhibit reproduction for arbitrarily chosen periods of time.

The present paper deals with the male animal; a subsequent paper will deal with the female. Each sex has an experimental advantage over the other. In the male the reproductive glands are so situated that they can be irradiated with little or no direct effect on the rest of the body. In addition to this favorable characteristic, it was thought that observations of sperm motility would play an important part in the determination of contraceptive exposures. On the other hand, the work of Long and Evans (1922), Corner (1923) and others, has brought our knowledge of estrus and ovulation in the rat to such completeness that the female is unusually appropriate to a study of factors bearing upon fertility.

The data here collected are far from complete but they contain a number of points of interest in connection with the problem. The outstanding result at the present time is the remarkable difference in resistance exhibited by different individuals; holding experimental conditions constant, it cannot be said with assurance that a given exposure will produce the same effect in any two animals. In order, therefore, to apply the procedure to an individual animal with nice confidence, means must be found for determining the onset and development of events which lead to an upset in the physiological function under investigation. In respect to this point the female offers better research material because of our knowledge of the estrous cycle and its relation to fecundity.

Material and Methods. Tame white rats were used as experimental animals, the parent stock coming from the Wistar Colony in 1921. They were kept and bred in roomy wire cages and fed an adequate basal grain ration supplemented daily with whole milk; in addition they received daily in rotation cheese, fresh vegetables and cooked meat. The environment was hygienic; fresh food was supplied each day and the bedding was changed and the cages cleaned at regular intervals. The animals were always manipulated with the hands and remained gentle.

Exposure. The animals to be exposed were wrapped in loose-meshed cheese cloth which in turn was wound with light cord.The effect was to obtain immobility without danger of injury. They were then placed in a form and all parts of the body except the area to be exposed were protected with an adequate lead shield. There was at no time any indication that this procedure as such was deleterious.

Sperm Motility. A testicle and epididymis were removed under ether, the epididymis opened and a small portion of the contents transferred on a knife blade to a drop of warm Ringer's solution. After slight stirring a cover-slip was laid over the drop and the preparation placed under the microscope. The Ringer's mixture which gave the best results was made up as follows: NaCl 0.9, KCl 0.03, $CaCl_2$ 0.04, $NaHCO_3$ 0.02 gram in 100 c.c.

This simple method gave uniformly satisfactory results. In unexposed animals and in animals with bodies irradiated but with testes protected with a lead shield, there was never difficulty in demonstrating actively motile sperm.

Roentgen-ray Apparatus and Dosage. Three different sets of apparatus were employed at different times.

Set A. A self-rectifying Coolidge tube was used on an alternating current with 50,000 volts in the secondary circuit and 3–3.5 inch spark gap. The average milliamperage was 7. Target distance, 9 inches. The milliampere-minutes necessary to give

one erythema dose (referred to as E.D. throughout this paper) under these conditions was calculated from Remer and Witherbee's formula for unfiltered radiation (1920):

$$\frac{\text{Sp. gap} \times \text{milliamp.} \times \text{Time (min.)}}{\text{Distance}^2} = 0.56 = 1 \text{ Erythema Dose (E.D.)}$$

Set B. The same apparatus was used as in Set A except that the voltage was increased to 70,000 (5 in. spark gap) and a one millimeter aluminum screen was used. The milliampere-minutes necessary to give one erythema dose (E.D.) under these conditions was calculated from Remer and Witherbee's formula for filtered radiation with a 1 mm. aluminum screen:

$$\frac{\text{Sp. gap} \times \text{milliamp.} \times \text{Time (min.)}}{\text{Distance}} = 8.5 = 1 \text{ Erythema Dose (E.D.)}$$

Set C. A different apparatus was used in this set. A Coolidge tube was run on a direct current at a 7 inch spark gap (80,000 volts) and a current of 5 milliamperes. A one millimeter aluminum screen was used. The target distance was 10 inches and the time necessary to give one erythema dose (E.D.) was taken as 4.52 minutes, according to MacKee's chart (p. 161) founded on Witherbee's work (1921).

The reader will understand from these descriptions that Set A furnished soft, feebly-penetrating rays, Set B furnished harder, more penetrating rays, while Set C furnished the hardest and most penetrating rays. It is sufficient here to indicate that the hardest rays were finally adopted to insure uniform penetration in the hope of obtaining consistent results. This hope was not realized, consequently no particular reference is hereafter made to the sets employed in the experimental procedure. Apparently all three sets were adequate for complete penetration of the testes, a fact which emphasizes the main deduction drawn from this work, namely, that the individual resistance of an animal dominates every other factor.

In irradiating the animals reported on in this paper, no uniform method was followed in administering the exposure. In some the total exposure recorded was given at one time, while in others it was variously fractioned and the fractions were administered at varied time intervals. It is possible that this failure of uniform procedure may be a disturbing factor, but careful and repeated analyses of the results in hand do not support the possibility. The same variability in outcome is as likely to be found in rats exposed at the same time as in those otherwise exposed. Consequently no further consideration will be given to this point.

Resistance of Rats. It is impossible to say whether the rat is more or less resistant to roentgen rays than other animals and man. Heavy dosage will cause death preceded by diarrhea, as described by Regaud, Nogier and Lacassagne (1912). Lighter dosage, but sufficient to affect the reproductive glands, causes no striking obvious ill-effect.

Radiation of Testes Only. If a rat is immobilized as described, and effectively screened with lead foil, it should be possible to irradiate the testes with practically no exposure to the rest of the body. It is of interest to know if such treatment has an effect otherwise than upon the reproductive capacity. The gain in body weight was used as an index and some of the results obtained are presented in Table 1.

Table 1 gives the experimental procedure, the animals used (with the dosage in parentheses if exposed to roentgen ray, the average body weight before and the weight in grams gained after two, four and six weeks. Set A was used on all of these animals. Deductions from these tabular data must be qualified by the small number of animals used and by the differences in the initial average body weights which indicate age differences.

When we thus take the gain in body weight as an index of the effect produced by exposure to roentgen rays, it is seen that irradiation of the whole body (abdominal surface) interrupts normal growth, the weight gain in the first two weeks being 5 grams as compared with 13 grams for the controls. This interruption is however subsequently compensated (not shown in the table) so that exposed animals gradually attain normal weight. Exposure of the testes appears to exert only a slight transitory depression upon growth likewise, as

indicated by similar figures, 13 and 17 grams respectively. The effect is however very much less when the testes alone are exposed than after exposure of the whole body. Castration under anesthesia causes a sharp depression of growth, but recovery is prompt. The fact that roentgen radiation of the testicular region after castration does not affect the growth suggests that roentgen-ray injury to any susceptible tissue produces toxic substances. In exposure of the testes alone the amount of such substance would be slight as compared with that released when the whole body is exposed.

Comparable results were obtained in a second series using younger animals and Set C. A summary of the data is given in Table II. Set C furnished a harder and consequently more penetrating ray than Set A. The table shows that the rats with only testes exposed suffered a transitory slow-up in their growth which was not as great, however, as in the castrated. This slow-up was soon compensated as in the first series. In the first two weeks the controls gained 53 grams while the irradiated animals gained 35 grams. At the end of six weeks, however, the gain was practically the same in both groups—92 grams for the controls and 86 grams for the irradiated. Later on (not shown in the table) even this slight difference disappeared just as in the first series. It is of incidental interest at this point to note that the animals irradiated with 2 or more E.D. were infertile for at least eight months, while those irradiated with 1.5 E.D. or less were credited with litters after an infertile period of about seven months.

Effect of Roentgen Ray on Sperm Production and Sperm Motility. Exposures of less than 2 E. D. were uniformly without effect upon sperm motility. But exposures in excess of this value did not yield uniformly consistent results. This uncertainty in the outcome of exposure of the testes to roentgen rays is a matter of considerable practical interest in connection with the general problem under investigation. These inconstant findings were at first attributed to lack of penetration by the gonad lethal rays furnished by Sets A and B. This explanation was supported by the fact that these sets with relatively soft non-penetrating rays in doses as high as 4 and 6 E.D. were without effect upon estrus and pregnancy in the female. When, however, Set C was used—in which case there was absolutely no doubt that all the gonad cells were effectively reached—the same inconstant results were observed. It follows, therefore, that the different animals show a quite remarkable difference in resistance to irradiation of the reproductive glands. This statement applies both to sperm motility and to the absence of sperm. The first (sperm motility) may be regarded as an index of fertility, the latter (absence of sperm) is certainly an indication of sterility.

Table III groups a number of animals to show this variability in the outcome of roentgen-ray exposure. The numbers in parentheses under each heading indicate the number of animals in each group. With an exposure of 2 E.D., all ten animals showed sperm present, which was motile in four and non-motile in six. With an exposure of 3 E.D., all seven animals showed sperm present which was motile in one and non-motile in six. With an exposure of 3.5 E.D., the single animals showed sperm present but non-motile. With an exposure of 4 E.D. five of the seven animals showed sperm present which was motile in two and non-motile in three. With an exposure of 6 E.D., two showed sperm present but non-motile and two showed sperm absent. The single animal exposed to as much as 8 E.D. showed sperm present. The heavier exposures, of course, tend to throw the animals into the non-motile or sperm-absent groups. All of the eighteen animals exposed to 3.5 E.D. or less showed sperm present, but in five the sperm were motile and in thirteen non-motile. Even with an exposure of 4 E.D. two animals showed motile sperm.

The presence or absence of sperm at the end of one month or longer is undoubtedly an unsatisfactory index of fertility since the matured or maturing cells at the time of exposure, although deleteriously influenced by the irradiation as indicated by loss of motility, might remain unabsorbed for some time. Motility is likewise perhaps an insufficient guarantee of fertility since in several instances males with motile sperm

TABLE I

THE EFFECT OF ROENTGEN-RAY EXPOSURE ON THE GAIN IN BODY WEIGHT

Experimental Procedure	Animals (Dosage in Parentheses)	Average Weight Before (Grams)	Average Gain in Weight (Grams) After		
			Two Weeks	Four Weeks	Six Weeks
Roentgen ray to whole body	12(2), 146[2](2), 124[2](3) 126(2), 178[2](2), 248(3)	182	5	20	31
Roentgen ray to testes only	134[5](3), 28[2](6), 138[5](3.5) 124[5](2.5), 136[5](2.5) 128[5](3.5)	130	13	25	47
Double castration	14[2], 126[5], 48[5], 68[5]	111	9	30	53
Double castration + roentgen ray to testicular region	6[6](3), 46[5](3)	148	18	28	41
Controls	24[2], 38[5], 78[5]	131	17	36	58
	24[2], 38[2], 78[5]	181	13	25	38

TABLE II

THE EFFECT OF ROENTGEN-RAY EXPOSURE ON THE GAIN IN BODY WEIGHT

Experimental Procedure	Animals (Dosage in Parentheses)	Average Weight Before (Grams)	Average Gain in Weight (Grams) After		
			Two Weeks	Four Weeks	Six Weeks
Roentgen-ray to testes only	134[5](3), 146[5](1.5) 158[5](1.5), 234[3](1.0) 238[3](2.0), 168[5](2)	91	35	63	86
Double castration	148[2], 136[7] 128[5], 156[5], 138[7]	102	32	54	83
Controls	2[2], 6[5], 16[2], 4[5]	101	53	79	92

TABLE III

THE EFFECT OE ROENTGEN-RAY EXPOSURE ON THE PRESENCE OR ABSENCE OF SPERM AND ON SPERM MOTILITY

Dosage	No. of Rats in Expt.	Animals with Sperm Present After One or More Months	Animals with Sperm Absent After One or More Months	Animals with Motile Sperm After One or More Months	Animals with Non-motile Sperm After One or More Months
2 E.D.	10	6, 28[2], 178[2], 16[3], 246[2], 124, 8, 12[3], 18[3], 12 (10)	.....	6, 28[2], 8, 18, (4)	178[2], 16[3], 246,[2] 124 12[3], 12, (6)
3 E.D.	7	34[3], 248[2], 234[2], 4[3], 2[3], 6[3], 24[3], (7)	.....	34[3], (1)	248[2], 234[2], 4[3], 2[3] 6[3], 24[3], (6)
3.5 E.D.	1	236[2], (1)	.....	.....	236[2], (1)
4 E.D.	5	368[2], 238[2], 34, 8[4], 34[4], (5)	28[2], 18, (2)	368[2], 34, (2)	238,[2] 8[4], 34[4], (3)
6 E.D.	4	14, 28, (2)	24, S[3], (2)	.....	14, 28, (1)
8 E.D.	1	36	.....	.....	36

failed to impregnate females proved fertile before and after this particular mating. These may be exceptional cases explained by lack of sex attraction, physical incompetence, fetal absorption, etc. Nevertheless the possibility should be held in mind that a sperm cell motile after exposure to the roentgen ray may yet be non-functional. However this may be, we see, at 2 E.D. exposure, motility in four and non-motility in six rats, while at 4 E.D. exposure there was motility in two and non-motility in three rats. Such results indicate a considerable variation in individual resistance and emphasize the necessity of finding some method by which the action of roentgen rays on the gonads of the individual can be determined before it will be possible to attain assured control of reproduction in the male.

TABLE IV

TIME WHEN SPERM MOTILITY IS LOST AFTER ROENTGEN-RAY EXPOSURE

Rat	Exposure in E.D.	Sperm Motile (Weeks)	Sperm Non-motile (Weeks)
178[2]	2	1	6
248[2]	3	2	6 (very feeble)
234[2]	3	2	6
236[2]	4	2	6
238[2]	4	2	6
14	6	..	6
28	6	..	6
S[3]	6	3	5
S[1]	8	3	5

A similar although less marked uncertainty obtains when we consider the latent period or time which elapses after exposure before motility is affected. Table IV groups a few animals to show this point. On the basis of these very limited data it appears that motility remains unaffected for two to three weeks and that non-motility (sterility?) is established five to six weeks after exposure. The most striking thing shown in the table, however, is that non-motility develops at approximately the same time regardless of the length of exposure. It will be understood that the time limits set in this table are only approximate, the figures representing the time in weeks when a testis was removed for examination. The closest approach to an exact determination occurred in animals S[3] and S,[1] in which the sperm were motile three weeks and non-motile five weeks after exposure. This would fix the time required to effect sterilization at about four weeks, regardless apparently of the degree of exposure. In none of the animals thus far observed has lost sperm motility returned.

Effect of Roentgen Ray upon Reproduction. The uncertain outcome which prevails in regard to sperm motility and sperm production obtains when reproduction is studied. Here again individual resistance appears to play so prominent a rôle as to overshadow most other considerations. The females used in breeding were not observed closely enough to exclude the possibility of interrupted pregnancies in some instances, but it is so highly improbable that the factor is of no moment in explaining the results.

The plan followed in testing the fertility of an exposed male was to mate him in sequence with several fertile females. The latter were then isolated and observed. When a litter was dropped, the male was credited with being fertile twenty-two days previously, assuming that pregnancy lasts twenty-two days in the rat (Long and Evans, 1922). In only a few cases was it feasible to breed the male with his mates before exposure, and only females which had been successfully bred previously were used.

The breeding histories of a number of exposed males are condensed in Table V. The reference number, approximate age and degree of exposure are given in the first three columns. The fourth column gives the time in days when the first fertile mating took place and the number of young in the litter. The last column gives the time of subsequent fertile matings with the number of young each time. In addition notation is made if the sperm was examined and if the animal was disposed of. Absence of the latter note means that observation is being continued.

As it stands, the data are quite limited but they contain a number of interesting facts in addition to the predominant one that with present available criteria we cannot foretell the outcome of roentgen-ray

TABLE V

BREEDING HISTORIES AFTER ROENTGEN-RAY EXPOSURE*

Rat	Age, Months	Dose	First Fertile Breeding (in Days) and Number in Litter	Subsequent Fertile Breedings (in Days) and Number in Litter
263 X.	4.0	0.5	1 day—5 young	8 days—7 young; 22 days—12 young; 57 days—12 young. Sacrificed
8[5]	3.0	1.0	None in 120 days. Motile sperm	Sacrificed
234[3]	2.0	1.0	217 days—6 young	
48 B.S.	11.0	1.0	None in 180 days	Died
26[6]	3.0	1.5	8 days—7 young	46 days—12 young; 57 days—12 young. Sacrificed
28[5]	3.0	1.5	30 days—7 young	64 days—8 young; sacrificed
278[6]	6.0	1.5	4 days—3 young	82 days—5 young
16 B.S.	6.0	1.5	55 days—4 young	82 days—5 young; died
6 B.S.	5.0	1.5	None in 210 days	Sacrificed
2 B.S.	5.5	1.5	None in 240 days. Motile sperm	
2 B.X.	18.0	1.5	None in 270 days	
24 B.S.	12.0	1.5	82 days—4 young	89 days—5 young; 138 days—1 young
4 B.S.	5.5	1.5	None in 240 days	
146[5]	1.5	1.5	155 days—4 young	
18 B.S.	5.0	1.5	55 days—5 young	75 days—4 young; 82 days—5 young; 117 days—1 young
158[5]	1.5	1.5	217 days—7 young	
46 B.S.	5.0	2.0	None in 240 days	Died
38 B.S.	7½	2.0	None in 240 days	
168[5]	1.0	2.0	None in 240 days	
348[6]	6.0	2.0	None in 60 days	
238[3]	2.0	2.0	None in 240 days	
6	?	2.0	None in 140 days. Motile sperm	Sacrificed
123[5]	2.0	2.0	None in 240 days	
46[6]	3.0	2.0	None in 120 days. No sperm	Sacrificed
146[2]	3.0	2.0	None in 30 days	Sacrificed
78[2]	3.0	2.0	5 days—3 young	Sacrificed
28 B.S.	6.0	2.5	96 days—7 young	
126 B.S.	7.5	2.5	48 days—4 young	96 days—7 young
34 B.S.	6.0	2.5	103 days—7 young	
356[5]	5.0	2.5	8 days—3 young	
1356[7]	5.0	3.0	12 days—2 young	
124[2]	3.0	3.0	168 days—5 young	Sacrificed
8 B.S.	7.5	3.0	None in 240 days. No sperm	
12 B.S.	6.5	3.0	None in 240 days	
14 B.S.	5.5	3.0	None in 240 days	
134[5]	3.0	3.0	None in 240 days	

* Rats 6 and 124[2] were exposed to Set A; rat 146[2] was exposed to Set B; all the others were exposed to Set C.

exposure on the fertility of any individual. As to the latter, the material in hand is even more impressive than that previously presented.

The exposure of these animals ranged from 0.5 to 3.0 E.D. An exposure of 0.5 E.D was without effect upon reproduction; the animal so treated was fertile on the first, eighth, twenty-second and fifty-seventh day after exposure. At the other exposures, 1.0–3.0 E.D., the results are conflicting although it is apparent that protracted infertility is more common with the longer exposures.

Three Animals with 1.00 *E.D. Exposure.* One died, cause unknown, at 180 days, without offspring; one was fertile at 217 days, six young resulting, and one was infertile for 180 days although he showed motile sperm after the last breeding.

Twelve Animals with 1.5 *E.D. Exposure.* One was infertile for 270 days, two were infertile for 240 days although one of them showed motile sperm after the last breeding. Another was infertile 210 days. Of the remaining eight, one was fertile on the fourth, one on the eighth, one on the thirtieth, two on the fifty-fifth, one on the eighty-second, one on the one hundred and fifty-fifth and one on the two hundred and seventeenth day after exposure. Taken as a whole, we find evidence of fertility 4, 8, 30, 46, 55, 57, 64, 75, 82, 117, 155 and 217 days after exposure.

Ten Animals with 2.0 E.D. Exposure. Five were infertile for 240 days. One was fertile on the fifth day. One, infertile for 120 days, was found to have no sperm cells, while another, infertile for 140 days, showed actively motile sperm.

Four Animals with 2.5 E.D. Exposure. All were fertile, one on the eighth, one on the forty-eighth, one on the ninety-sixth and one, one hundred and third day after exposure.

Six Animals with 3.0 E.D. Exposure. Four were infertile for 240 days. In one of these no sperm cells were found. One was fertile twelve, and another 168 days after exposure.

In each of these exposure groups there are rats which remained infertile as long as observed and rats which were fertile at various times after exposure. There is absolutely no consistency in the results. In the 1.5 E.D. group, for example, three were infertile for 240 days or longer, while the others were fertile 4, 8, 30, 55, 82, 155 and 217 days after exposure. There is thus consistency neither in the matter of permanent sterility nor in the length of time in which fertility may be inhibited. This point is further emphasized by two of the rats exposed to 2.0 E.D. in one of which sperm cells were entirely absent and in another of which actively motile sperm was found.

Attention should also be drawn to the three rats which were bred unsuccessfully although they were found to possess normally motile sperm. This would seem to indicate, as pointed out above, that sperm motility is not a reliable index to fertility.

DISCUSSION

The experimental results presented in this paper accord with the accepted opinion (MacKee, 1921) that exposure to roentgen rays may cause permanent sterility or inhibit fertility. In the early days of roentgenology, before protective aprons, etc., were employed, many, but not all, operators were rendered infertile. When protection of the body became general, it was found that previously established infertility disappeared in some but not in all operators. It was inferred that this difference in power of recovery was due to different degrees of exposure or to age differences in those exposed, the view being that the younger men recovered while the older ones did not recover normal fertility. It would seem, however, from these results on rats, that neither of these alternatives is acceptable. In the first place, reference to Table v makes it clear that age is not a determining factor either for the establishment of sterility or for the duration of inhibited fertility. In the second place, the degree of radiation was strictly comparable in cases in which the resultant effect was so various.

A more probable explanation of these findings lies in the difference of individual resistance. This factor has, of course, been recognized by roentgenologists but perhaps not to the degree emphasized in this paper. It appears that idiosyncrasy to roentgen-ray exposure plays as great if not a greater rôle than does idiosyncrasy in the exhibition of drugs. It would be of interest to correlate the roentgen-ray effect upon reproduction with other physiological changes in the body, to see if safe criteria can be found according to which exposures directed to the inhibition of fertility can be established.

Permanent infertility or sterility is doubtless associated with destruction of the primitive gonad cells. Temporary or transient infertility which sometimes follows roentgen-ray exposure may be due to (*a*) a systemic effect; (*b*) an effect on libido; or (*c*) an effect upon the matured and maturing sex cells.

(*a*) *Evidence of a Systemic Effect.* Ten rats (14,[3] 26,[3] 28,[3] 34,[3] 36,[3] 46, 126, 368,[2] 468[2] and 1234[2]) were exposed to 2-5 E.D. with the testes protected with lead shields. When examined one and a half to three months after exposure, all showed vigorous sperm motility. When bred, they all reproduced 6 to 12 young one to three months after exposure. Thus exposure of the body with the testes adequately protected does not affect fertility.

(*b*) *Evidence of an Effect on Libido.* The only observations collected on this point are the three cases reported in Table v, in which the rats failed to reproduce although normally motile sperm were found. If it is assumed that motile sperm are an indication of fertility, these rats

did not show normal libido. The observations were made too long a time after exposure to explain the results by possible systemic upsets. We know too little about sex impulse in the rat to speculate profitably on this point. On the other hand, clinical experience indicates that roentgen-ray exposure does not affect libido in man (MacKee, 1921). The same is probably true for experimental animals (Albers-Schönberg, 1903). Probably inhibition of libido does not account for transient infertility in rats.

(*c*) *Evidence of an Effect upon the Matured and Maturing Sex Cells.* Transient infertility would seem, by exclusion, to be due to an effect produced upon the matured and maturing sex cells. No evidence has been gathered on this question. Such an explanation implies (1) that the matured cells at the time of exposure are somehow inhibited in their normal functional power, and (2) that the maturing cells back to a certain phase in spermatogenesis, depending upon the duration of infertility established, must likewise be inhibited or destroyed. It is probable that careful histological study of exposed testes might throw some light on this point. The papers by Bergonié and Tribondeau (1905) and Barratt and Arnold (1911), important as showing pathological changes, do not bear on the consequences produced by graded exposures. The young sex cells may be injuriously affected or merely inhibited in their growth. However this question is answered, it is interesting to observe that we are not here dealing with a difference in the resistance of individual cells. All or none, beyond a certain stage of development, are similarly affected. The difference in resistance apparently has to do with the whole animal and not with his individual sex cells.

Bagg and Little (1924), using mice, obtained their first litters thirteen and fourteen weeks after exposure. They gave, according to the standards here used, 0.32 E.D. divided into five daily exposures. These investigators were concerned wholly with the production of hereditary defects, not with the immediate consequences on reproduction. Of their 20 treated males, 14 were either sterile or died. The 6 remaining were infertile for thirteen to fourteen weeks, as stated. The point of interest is that mice exposed to one-third of an erythema dose with dorsal exposure were rendered infertile for thirteen to fourteen weeks.

Snyder (1925), working with male rats, seems to have obtained a somewhat different outcome. He states that when he used a "thick" aluminum filter fertility was unaffected regardless of the length of exposure, and concludes that the hard rays are innocuous. The effect with a "thin" aluminum filter was the same as with unfiltered rays, and the filter was therefore discarded. Synder reports, according to the standards here used, that 3.18 E.D. was without effect while 3.64 E.D. established a sterility period. Data are given for 8 animals. This sterility period did not appear at once. Males exposed to 3.64 E.D. at a single treatment, continued fertile for a time. He gives this time as running from the exposure until the birth of the last litter before infertility set in. Deducting twenty-two days for gestation, to make the figures comparable with those here reported, fertility was uninterrupted in these 8 rats from two to forty-three days with an average of 27.7 days. The sterile interval then developed, after which normal fertility returned and continued indefinitely. This period of infertility lasted from forty-four to 132 days, with an average of eighty-five days. Synder explains the delay in onset of infertility by assuming that the mature sperm cells are not affected by roentgen-ray exposure.

The results of Snyder and of Little and Bagg agree in that they are consistent; they disagree in that Synder finds a delay in the development of infertility, while Little and Bagg find that infertility develops at once. The results reported in the present paper are conspicuous for their inconsistency and thus do not support either of these positions.

SUMMARY

Male rats were submitted to various roentgen-ray exposures and observed for the effect on (*a*) sperm motility, and (*b*) fertility. While it is readily possible to produce non-motile sperm and aspermia

as well as transitory infertility and sterility, it is quite impossible to standardize the exposures so as to foretell with any degree of certainty the effect which will be produced on the reproductive glands. This inability to obtain even approximately consistent results indicates an extreme difference in individual resistance not hitherto recognized in studies of this kind.

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UNITS IN SUPERFICIAL ROENTGENOTHERAPY

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UNITS in roentgen-ray work have marked eras of progress. The disuse of each one has been caused by a further understanding and conception of the principles of roentgen therapy, just as the advent of each unit has also marked a progress in knowledge. The Sabouraud-Noiré pastille, the Holzknecht, Hampson, and Corbett radiometers, the Kienböck quantimeter and others have each had their place and have denoted epochs in radiotherapy. The Fürstenau intensimeter is popular abroad, and among scientists the International Radium Standard serves as a means of measuring the energy output of roentgen-ray bulbs.

In this country a great advance in practical work in superficial therapy was made by the application of mathematical calculations and formulas for indirect technique through the work of MacKee,[1] and Remer and Witherbee.[3] Although still in force and of inestimable practical value in unfiltered dosage, an increase of our knowledge since their advent has brought to light discrepancies and inaccuracies in these formulas. Dosage does not vary as the voltage, but approximates the square of the voltage. Until spark gaps and various other structural inconsistencies are of uniform manufacture, variations of voltage in spark gaps of the same length will be considerable. The size of the area treated is a factor of importance not considered in their formulas. For illustration, in an area one square centimeter in size, the amount of secondary radiation is incomparable to that in an area of the size of 50 square centimeters.

It has been shown[6] that the skin toleration for variations in roentgen-ray dosage is considerable. Tubes having different energy outputs show no noteworthy differences in skin effects when used with the same factors on the same machine. This is particularly true in filtered superficial therapy where twice, or in some instances three or four times the erythema exposures, will give such little difference in skin effect that those who have been accustomed to studying skin effects for years[3,6] have noted no differences. It would seem that

the range of skin toleration is sufficient to account for the great practical benefit already derived from methods of measurement now known to be very inaccurate.

The unfiltered skin unit has been a convenient form of expressing the arithmetical factors 6-in. spark gap, 3 ma., 8-in. distance for 2 min., or 6-in. spark gap, 2 ma., 8-in. distance for 3 min. MacKee defines it as a dose which will produce a mild skin reaction in the average individual, usually an erythema on sensitive parts, or on the scalp an epilation without an erythema. As such a standard, it has been of widespread use. When employed to compute other formulas or dosage as with an 8-in. spark gap. 3 ma., at 8-in. distance for 1.5 min., it is an inaccurate method, but still exceedingly useful when accepted with recognition of its weakness in regard to voltage.

For illustration:

$$\frac{6'' \text{ spark gap} \times 3 \text{ ma.} \times 2 \text{ min.}}{8'' \text{ dist.}^2} = \frac{9}{16} = \frac{8'' \text{ spark gap} \times 3 \text{ ma.} \times 1.5 \text{ min.}}{8'' \text{ dist.}^2}$$

The filtered unit is endless in complexity and means very little. Remer and Witherbee[3] gave a formula for filtered dosage based on pastille effects in which one skin unit filtered is given as the equivalent of four Holzknecht units (pastille at ½ skin-anode distance)—H1S.D. MacKee states that it is advisable to think of the filtered erythema dose as a filtered unit, which corresponds to H2S.D. and fractions thereof as constituting fractions of this filtered unit but not as fractions of H units; but in dosage charts gives the erythema dose as two filtered units.

We know that Remer and Witherbee's idea that intensity of filtered radiation varies as the distance and as the voltage is inaccurate, and that with the different types of spark gaps in various makes of machines, the length of spark gap is not an accurate general measure of the voltage. We also know that tubes of the same breadth of focus and make vary in energy output.[5,6] Variations of the density of filters upon the same primary beam produce marked differences in the radiation which reaches a patient. Whereas the coefficient of absorption at 120 kv. on a sharp point spark gap of 8 inches is approximately 66 per cent of the total output for 3 mm. of aluminum and 46 per cent for 1 mm. of aluminum, these coefficients will vary greatly with changes in the voltage, other factors remaining constant. It has long been common knowledge that the erythemas and other biological effects of lightly filtered roentgen rays are histologically and clinically very different from the effects caused by heavily filtered roentgen rays.

In Europe the unfiltered unit has unfortunately not received the attention which it deserves, but on the other hand, perhaps fortunately, the filtered unit has, it seems, never been heard of. Throughout Germany, France, and England, the Scandinavian countries and South America, and among the deep therapists in this country, the filtered unit has received no recognition, and always the term erythema exposure is used as a standard of measure, to which are suffixed the factors and perhaps the ionization measurements. In superficial therapy in this country the filtered unit has had its advent, but scarcely anything more. With its advent came its complexity, lack of meaning and inaccurate formulas with possibilities of mistakes.

It would seem best for those engaged in superficial therapy to drop the use of the filtered unit with the assurance that this step results from a progress in our knowledge of filtered superficial therapy. Until another filtered unit appears, it might be well to turn to the old terms of epilating and erythema exposures which have withstood the years since the beginning of roentgen therapy, and to estimate the dosage only when the complete specific factors are listed.

Bachem[7] has developed a formula containing a physiobiological factor based on ionization measurements with a Fürstenau instrument, which is a decided improvement over the other formulas which have been mentioned. The Fürstenau intensimeter depends upon the alteration of the resistance of selenium.

If ionization chambers did not vary greatly in delicacy, an ionization unit

might have more general application. One objection is the extreme sensitivity of the galvanometer or electroscope required.[8,9] This margin of error may be lessened by taking the average of several readings. The ionization currents are very feeble and the instrument must be so sensitive that it is easily disordered by vibrations. In most chambers the calibration of the scale would be different for various wave lengths, which variation may be minimized by the use of a keratin and graphite chamber. By a spectrometer, ionization measurements of various wave lengths may be made.

It is possible[8] by measuring accurately the volume in which ions are formed to calculate from the observed galvanometer current the ionized current due to each cubic centimeter, which is the quantity of electricity contributed each second by each cubic centimeter of the ionized air. A current is measured by the quantity of electricity passing any point in a circuit each second. According to Robertson, one ampere equals one coulomb per second, which in turn equals 300,000,000 absolute electrostatic units per second. The absolute electrostatic unit of quantity is such that the force of repulsion between two such units placed one centimeter apart in air is one dyne. That roentgen-ray beam which will produce one absolute electrostatic unit of current per second in each cubic centimeter of air through which it passes, provided the current has its saturation value, gives a dose of one electrostatic unit (Duane[10]). These measurements are made with a galvanometer which measures the intensity. The erythema skin dose has been found by Duane, Pfahler and others to be between 700 and 1500 E.S.U.

Stevens[4] expresses an electrostatic unit of radiation as the quantity of radiation sufficient to ionize each cubic centimeter of air in the radiation beam, so that it will allow a passage of one electrostatic unit of current, and considers 170 electrostatic units an erythema exposure, using heavily filtered radiation and a Fürstenau instrument which is calibrated to the unit of potential; i.e., 300 volts. For lighter filtrations this figure is to be greatly lessened. Stevens' method of measurement follows that of Friedrich and Kroenig[11] who use an electroscope to measure the physical dose expressed as the quantity of roentgen rays which transports in one cubic centimeter of air by ionization the quantity of electricity equal to one electrostatic unit with a saturated current. Their unit is represented by the letter "e." The skin erythema dose is given as 165 e to 170 e.

As explained by Robertson,[8] this is a unit of dosage and must not be confused with Duane's E unit, which is a unit of intensity. Apparently Friedrich and Kroenig's e should be multiplied by 10 to equal Duane's E. Friedrich and Kroenig's e is measured with an electroscope and Duane's E.S.U. is measured with a galvanometer. Duane's method has the advantage of giving both the intensity and the time. Feeble intensity for a long time has not necessarily the same biological effect as great intensity for a correspondingly short time. Robertson states, however, that both units are absolute and therefore adaptable for international usage.

Unfortunately, ionization chambers are not generally calibrated to any standard of universal application. Radium may be used for this purpose by the individual dermatologist, but no radium standard has been universally accepted, and for general clinical application the quantity of the ionization of the air in the chamber caused by any amount of radium varies as to the size and shape of the chamber, the thickness and density of its walls, and the position of the radium to the chamber. When the gamma rays are projected parallel to the long axis of a tubular chamber their ionization is far greater than when otherwise directed, within practical distances. Solomon's[12] ionometer is an ionization chamber with an electroscope. The scale, however, is calibrated in terms of "the ionization produced by one gram of radium element in one second, placed at a distance from a chamber of twenty millimeters and screened by 0.5 mm. of platinum." This is called 1 R unit, the erythema dose being 1000 R. The manufacturer supplies the number of R units which correspond to the full

scale of deflection of fifty divisions, when each instrument is sold.

The following method offers a fairly accurate system of measurement of roentgen-ray energy output, and estimation of exposure times that will produce similar skin effects, with various spark-gap lengths.

If the distance, the current, the time, and the filtration are kept constant, and certain ionization effects are produced with certain voltages, it is possible to compare the exposure times at various voltages necessary to produce approximately identical skin effects, disregarding errors caused by differences in tube output inherent in the tubes and differences caused by variations in size of the area treated. This means that if one who is doing superficial therapy and owns an ionization chamber makes readings of output for his more commonly used filtrations at the voltages found to correspond with his more commonly used spark-gap lengths, it is possible to make a ratio of the exposure times at various voltages which will harmonize with definite skin effects. The exposure times would change in the same proportions as the ratios for the spark gaps in the table. Because of differences in spark-gap points, and because of differences in the energy output of tubes of the same focus and make, it is well for the individual dermatologist to make his own readings upon his own machine and tubes, and thus determine his own ratio.

For example, let us suppose that the ratios of the exposure times necessary to discharge the same units on the scale of an ionization chamber, other factors and filtration remaining constant, are as follows:

9 inch spark	2
8 inch spark	3
7 inch spark	4
6 inch spark	5

Let us assume that the given factors are 9-in. spark gap, 5 ma. at 10-in. distance through 3 mm. of aluminum with which an erythema is obtained with an exposure time of 8 minutes, and it is desired to find the exposure time required to produce a similar erythema with the same factors except that the spark gap is decreased to 7 in. This would then be computable as follows: 8: X::2:4, or 32 over 2X. X equals 16. Calculations of this type will be more accurate than those not checked by ionization readings, and with the approved types of ionization chambers can be readily made. Once the ratio is established, the computation will be simply arithmetical, and it is possible to establish such a table for the more common lengths of spark gaps and thicknesses of filters in a few hours. It is applicable to unfiltered radiation and requires but a few minutes to make such an ionization table for various spark-gap lengths or voltages without filters. However, such a manner of computation is not usable generally as an expression of dosage for which purpose units are intended.

The success of the unfiltered skin unit has resulted from its convenience, ease of measurement, constancy, and reproducibility. Fractions or multiples of it are simply figured. A unit for filtered superficial therapy must combine these advantages and also be applicable to the whole range of wave lengths commonly used, and the absorption of the measuring substance must vary with the wave length in a manner similar to the variation of absorption by tissue. The filtered unit should also correspond to some definite biological effect.

In ionization chambers, the absorbing substance is air, whose absorption has been shown to change in wave lengths in the same manner as water and as tissue. If a simple ionization set consisting of a chamber, a galvanometer, and a scale for reading the deflection of the needle is employed, in which the scale has been calibrated by the manufacturer, so that one can read in the E.S.U. of Duane or any other universally applicable unit, a very limited knowledge of physics is required to make the estimations. It is urged that manufacturers of ionization chambers in this country adopt the Duane unit and calibrate the scales registering deflection of the galvanometer to this standard.

As pointed out by Simpson,[13] the absorption of energy from short electromagnetic

waves is an electronic property of matter. The energy of the wave is transferred only to electrons which can vibrate in harmony with the rate of the wave pulse, similar to the transfer of sound waves from one vibrating medium to another in resonance with it. In the case of very short rays so few electrons are encountered that can vibrate in harmony that the pulse must pass through enormous numbers of electrons, (i.e., great masses of matter) before it loses much energy. With soft rays more electrons are encountered that can vibrate in harmony and thus the soft roentgen-ray impulse loses its energy more easily, or in other words, is more readily absorbed.

It would seem that ultimately we must come to measurement of wave lengths as well as quantity of output, in order to accurately estimate dosage. A combination of spectroscope and ionization instrument calibrated to read in Duane, E.S.U., would seem of prospective importance.

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TETRAIODOPHENOLPHTHALEIN SODIUM SALT*

BY H. T. CLARKE, D.SC., AND E. E. DREGER, PH.D.

ROCHESTER, NEW YORK

THE increasing use of tetraiodophenolphthalein sodium salt for gallbladder examination renders desirable a description of this little-studied compound. It was first described by Classen and Löb[1] as an amorphous solid, blue in color when containing water of crystallization and light brown in the anhydrous condition. These authors state it to be very stable, though decomposed by carbon dioxide on long standing in air. A more detailed study has more recently been made by Orndorff and Mahood,[2] who describe a disodium salt of tetraiodophenolphthalein, containing 5 molecules of alcohol and one molecule of water of crystallization, as a pale green crystalline substance which becomes blue on removal of the combined alcohol and water.

Our observations on the hydrated sodium salt which forms the subject of the present note agree closely with those of Orndorff and Mahood on the alcohol-containing salt. It crystallizes in short prisms which possess a pale blue color when viewed in bulk and appear practically colorless under the microscope (Fig. 1). Analysis of the air-dried crystals shows them to contain 55.2 per cent of iodine, 4.85 per cent of sodium, and 6.94 per cent of water, corresponding to the formula $C_{20}H_8O_4I_4Na_2$, $3\frac{1}{2}H_2O$, which requires 54.7, 4.95, 6.78 per cent respectively. When dehydrated by heating at 140–150°C., the salt becomes deep blue; this effect can also be brought about by crushing the crystals. Dilute solutions of the salt are rapidly decolorized on exposure to sunlight, and the crystalline product itself becomes decomposed on the surface on long exposure. This change may be due to oxidation; it appears to be retarded by the presence of a sulfite and accelerated by caustic alkali, but no iodine is eliminated in the form of iodide. The color of a dilute solution is intensified on heating, but returns to its original intensity on cooling. The solubility of the salt in water is approximately 12 per cent at 20° and 40 per cent at 80°. It dissolves readily in alcohol.

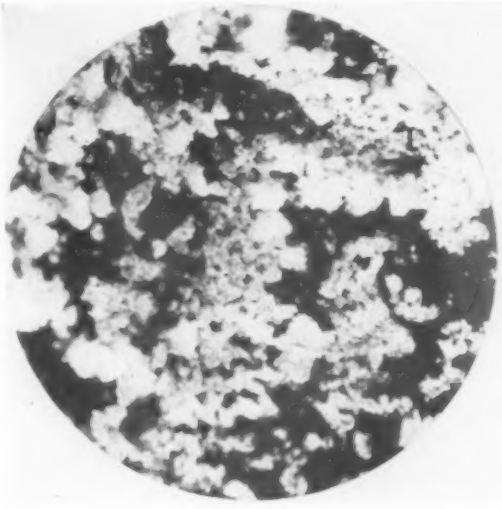

FIG. 1.

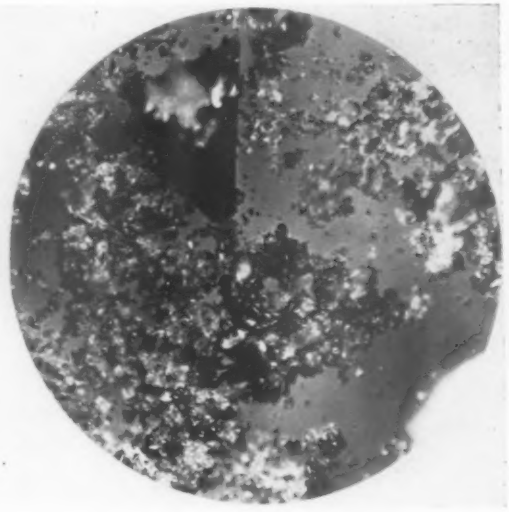

FIG. 2.

The salt described by Classen and Löb was evidently impure; this may possibly be attributed to the formation of a by-

* Communication No. 245 from the Research Laboratories of the Eastman Kodak Company.

product which, like the true tetraiodophthalein, contains combined iodine, and is insoluble in water but soluble in alkali. The sodium salt of this by-product is amorphous; and when impure tetraiodophenolphthalein is dissolved in alkali and the solution slowly evaporated to dryness, the crystalline salt is embedded in the amorphous impurity (Fig. 2). This by-product can be removed only by repeated recrystallization from water.

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Information of interest to all readers will be found on page iii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found below.

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Advisory Board for Pathology: JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

Publishers: PAUL B. HOEBER, Inc., 67-69 E. 59th St., New York City.

Twenty-seventh Annual Meeting: Book-Cadillac Hotel, Detroit, Michigan, May 18–21, 1926.

THE AMERICAN RADIUM SOCIETY

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EDITORIALS

THE ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

The annual meeting this year was characterized by a large attendance and by unusual enthusiasm in the scientific meetings. All of the papers will be published in the Journal within the next few months and no comment upon them is necessary here. It was generally agreed that the program this year was of unusual value from the practical clinical standpoint and that some of the papers were real permanent contributions to scientific knowledge.

The Caldwell Lecture was delivered by Dr. James Ewing, on "Tissue Reactions to Radiation." The subject was covered in Dr. Ewing's usual clear and comprehensive style and will be available to the readers of the Journal at an early date.

The Leonard Prize was divided this year into two parts. The first prize of $600 was awarded to Drs. Evarts Graham, Cole and Copher for a paper on the "Development of Cholecystography," and the second prize of $400 to Dr. G. Failla and his coworkers at the Memorial Hospital for a paper on "Dosage Study Relative to the Therapeutic Use of Unfiltered Radon." Honorable mention was given to the paper of Drs. Sosman and Vogt on "Aneurysms of the Internal Carotid and Circle of Willis."

The following officers were elected for the ensuing year: President-elect, Dr. Russell D. Carman, Rochester, Minn.; First Vice-President, Dr. P. F. Butler, Boston, Mass.; Second Vice-President, Dr. Charles Richards, San Jose, Calif.; Secretary, Dr. Charles L. Martin, Dallas, Texas; Treasurer, Dr. Wm. A. Evans, Detroit, Mich.; Librarian, Dr. H. W. Dachtler, Toledo, Ohio; Member of Executive Council, Dr. William Doughty, Cincinnati, Ohio.

An important change was made in the time of the annual meeting. For many years the Society has met in the fall of the year but there has been increasing objection to this time. Among the objections are the difficulty of obtaining material for the program at the end of the vacation period and of securing the attendance of teachers at or near the opening of the college year. For these and other reasons the executive council decided to hold next year's meeting in the spring. The meeting will be held in Detroit, May 18–21, at the Book-Cadillac Hotel. Dr. Carman is already considering the program and anyone who will have work to present at that time would do well to write to him at an early date.

The golf tournament in connection with the meeting this year took place at the Congressional Country Club. For the second time in succession Dr. Willis F. Manges won the prize for low gross with a card of 79 over a long and difficult course. Dr. William Doughty had the low net score.

The national scope of the American Roentgen Ray Society was well demonstrated at this meeting. There were members in attendance from San Diego, Los Angeles, San Jose, San Francisco and Portland on the Pacific Coast, from all of the important middle western cities, a good representation from the South and a large attendance from New England and throughout the East.

DISCONTINUANCE OF SECTION MEETINGS

For several years it has been evident that meetings devoted to roentgenology and radium therapy have become so frequent as to impose a great burden upon those who must attend them. Such meetings are now held at such short intervals that they constitute a great drain both financially and in time upon the comparatively few men who are depended upon to furnish the programs. The undue multiplication of meetings also results

inevitably in deterioration in the quality of the programs presented.

Agitation to reduce the number of meetings resulted in action by the American Roentgen Ray Society at its recent annual meeting to discontinue its sectional meetings. This action along with the previous decision of the Radiological Society of North America to discontinue its mid-summer meeting brings about a reduction of four annual meetings in the United States.

The meetings now of national scope in North America are those of the American Roentgen Ray Society, the Radiological Society of North America, the Section on Radiology of the American Medical Association, the Canadian Radiological Society, and the American Radium Society. In addition to these there are the annual meeting of the radiological section of the Southern Medical Association, which meets annually, and a considerable number of state and city societies which hold one or several meetings a year.

There seems no doubt that the number of meetings could be still further reduced without interfering with the progress of roentgenology and radium therapy. In the meantime, the discontinuance of the sections of the American Roentgen Ray Society and of one of the annual meetings of the Radiological Society is looked upon by the majority of roentgenologists as a distinct gain.

THE TREATMENT OF HYPERTRICHOSIS BY THE ROENTGEN RAY

A NEW FIELD FOR QUACKERY

From a theoretical standpoint, the roentgen ray would appear to be the ideal agent for the treatment of hypertrichosis. Experience has shown, however, that normal hair cannot safely be epilated by the roentgen ray without the risk of ultimate damage to the skin. The risk is great enough to absolutely contraindicate the use of roentgentherapy for removing superfluous hair. With this opinion the vast majority of roentgenologists and dermatologists are in entire accord. It is alarming, therefore, to learn that this improper and dangerous method of treatment is now being exploited on a large scale by advertising quacks. Their activities have thus far been chiefly confined to New York City, though they are now rapidly spreading to other sections of the country.

In New York there are several advertising institutions where scores of women are being gulled by false statements concerning the safety of this "new" method of treatment. Some of the charlatans in charge of these institutions frankly admit that they use the roentgen ray. In fact, one of them said that he followed MacKee's textbook, though his technique was hopelessly crude. Others infer that they do not use the roentgen ray but some mysterious new "wave length" to accomplish their results. Their advertising circulars include partial and misleading quotations from recognized authorities.

The disastrous results which would logically be expected are now beginning to make their appearance and unless a check is soon put upon this form of quackery the number of unfortunate victims will eventually be large. It is also quite probable that these bad results will lessen the confidence of the public in roentgenotherapy in general, even when practised by men of the highest skill and reputation.

In the campaign to combat this recent form of quackery, investigations have been made by a committee from the Section of Dermatology and Syphilis of the New York Academy of Medicine. Whether the evil can be lessened or stamped out by legal methods remains to be seen. For the present it is earnestly requested that every physician who sees any of the unfortunate victims, send complete data concerning them to the Bureau of Investigation of the American Medical Association. Suitable action can be taken only after a reasonable mass of evidence has been obtained. The writer has recently discussed this subject in the course of an address on dermatologic quackery and would be glad to give more detailed information to those desiring it.

HOWARD FOX.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES

WE contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

THE CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.
Meets annually.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

THE NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Charles W. Blackett, 35 Bay State, Rd., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Edward S. Blaine, 2005 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. C. J. McCullough, Decatur, Illinois.
Regular meetings held quarterly.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Torino, Torino.

THE BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London, W. 1.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medcine, 1 Wimpole St., London, W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Meets in Amsterdam every second month except in the summertime.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prag, II/52.
Annual Meeting in Prag the last week of October.

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, Cleveland, Ohio, December 7–11, 1925.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. M. J. Hubeny, 25 E. Washington St., Chicago, Ill.
Annual meeting, Dallas, Texas, April 19–23, 1926.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Annual meeting, Dallas, Texas, Nov. 9–12, 1925.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

ROENTGEN MEETINGS IN NEW ZEALAND

A communication from Dr. P. D. Cameron of Wellington, New Zealand, informs us that a radiological section has been formed in the New Zealand British Medical Association. The first meeting was held at Timaru on February 21, 1925, and is reported in the New Zealand Medical Journal for April, 1925. The secretary is Dr. P. C. Fenwick, The Hospital, Christchurch. Dr. Cameron also informs us that the Australasian Medical Congress will meet at Dunedin, New Zealand, during February, 1927. A special radiological section of this Congress has been arranged of which Dr. C. A. Anderson, The Hospital, Dunedin, is secretary.

REPORT OF THE FIRST INTERNATIONAL CONGRESS OF RADIOLOGY, LONDON, JULY 1–4, 1925

BY G. E. PFAHLER, M.D.

Philadelphia, Pennsylvania

The First International Congress of Radiology that has ever been held came into existence through the primary efforts and invitation of our British colleagues; in fact according to the President, Dr. C. Thurstan Holland, the call of the congress developed because of the initial but quiet and continued efforts of Dr. Robert C. Knox. Its success, however, depended upon the united efforts of the British scientists who are interested in radiology, and to the general and enthusiastic response and cooperation of the radiologists from all civilized countries.

There were present 367 members representing 24 countries. All nationalities seemed to feel the need of such an assemblage and all showed a splendid cooperative spirit. The program was published in the Journal in advance of the meeting, and space will not permit a detailed description of the social and scientific events. Suffice it to say that our British colleagues lived up to their reputation of splendid and magnificent hospitality.

The commercial exhibit held interest everywhere, but the two exhibits that seemed to attract most attention were the metal roentgen-ray tube, and the improved Holfelder field selectors. Phillips' "Metalix" tube consists of a metal cylinder approximately 15 inches in length and 2½ inches in diameter. The roentgen rays are emitted from one end. The protective value of the general diagnostic tube is equivalent to $\frac{3}{32}$ of an inch of lead. Its great advantages seem to be the inherent protection, the comparative ease of manipulation, because of the relatively small tube stand required, and its freedom from breakage. Its general durability I think has not yet been determined. The roentgenograms which were demonstrated were equal to but not better than those made with standard Coolidge tubes. Its use would probably require a general readaptation of our present roentgen-ray tables and tube stands.

The Holfelder Improved Field Selectors consist of a series of diagrams of sections of the body; a series of truncated pyramids of celluloid stained so as to represent the light value of various roentgen-ray beams coming from transverse and oblique angles, superimposed over a special illumination box and directed in such manner as to represent the radiation value in a given part of the body or in tumor tissue in relation to the surface.

The scientific sessions were divided into: (1) Section of Physics. (2) Section of Electrotherapy and Actinotherapy. (3) Radiology Section, which was divided into Diagnosis, Roentgen Therapy, and Radium Therapy. It was obviously impossible for any one to attend all of these sessions for at times three sessions were being carried on simultaneously. Some of the authors have very kindly furnished me with abstracts of their papers, and so far as is possible I believe they are best published as the authors have prepared them. Stenographers were unfortunately not furnished to record the discussions. Some of these discussions were personally recorded and are to be published with the scientific papers in the British Journal of Radiology during the coming year. This will involve considerable delay. Therefore,

it will be some advantage to have these abstracts published in advance. Those who are sufficiently interested can then subscribe for the British Journal and secure the complete articles.

RESOLUTIONS

At meetings of the delegates held on July 4, 1925, at this Congress the following resolutions were passed.

1. That this Congress in London is the First International Congress of Radiology.
2. That Mr. C. Thurstan Holland is elected President; and that at future Congresses the delegates shall elect the President on the nomination of the country holding the meeting.
3. That further International Congresses shall be held at intervals of three years, or at such an interval as the delegates at each Congress shall decide.
4. That the next Congress shall be held in Stockholm in 1928 and that Professor Gösta Forssell shall be the President, on the nomination of the delegates from Sweden.
5. That any country having a roentgen society or societies shall be entitled to send not more than five official delegates to each Congress; but only one vote shall be exercised by each country.
6. That the country in which any Congress is held shall be entirely responsible for all the Congress arrangements, financial and otherwise.
7. That Prof. G. Forssell be appointed Chairman, and Mr. C. Thurstan Holland Vice-Chairman; that Dr. Stanley Melville (the Secretary-General of the London Meeting) be appointed the Secretary of the International Delegate Committee until the next meeting of delegates.
8. That a sum of money not exceeding £20 shall be allotted to the Secretary of Delegates from the funds of each Congress meeting to cover his expenses.
9. That these resolutions shall be forwarded to the editors of radiological journals with a request for their publication.

ABSTRACTS OF PAPERS READ BEFORE THE CONGRESS

BÉCLÈRE, A. On international standardisation of measures in roentgenotherapy.

The rays discovered by Roentgen in November, 1895, became, the very next year, in the hands of Dr. Freund of Vienna, a therapeutic agent.

This new medication, roentgenotherapy, without any dosage either in quality or in quantity, progressed by chance, as if groping in darkness.

In 1901, the French physicist, Benoist, devised the first qualitimeter. From that moment, radiotherapists were able to designate with numbers the average penetrative power of the various, more or less complex radiations which they used.

In 1902, Dr. Holzknecht of Vienna devised the first quantimeter and proposed the first quantitative unit of measure, unit H. He thus transformed this new and until then very uncertain agent into a really scientific method. Henceforth radiotherapists were able to measure and to dose the quantity of rays that penetrates any region of the body exactly as in usual therapeutics they measure the dose in weight and quantity. This quantimeter is for them equal to a balance, imperfect but very useful. It enables them to express in physical units the various therapeutic doses and is enough to prevent errors.

To Holzknecht's original device there soon succeeded the bariumplatinocyanid tablet of Sabouraud and Noiré in Paris and the Kienböck photographic paper in Vienna. Holzknecht's unit is nevertheless conserved and, in late years, his new quantimeter based on Sabouraud-Noire's tablets, enables more accurate and precise measures. I will not mention other physico-chemical reactions less used as means of dosage measurement.

Roentgen discovered the property roentgen rays have to ionize gases, thus becoming electric conductors. This property, also belongs, as Henri Becquerel discovered, to the rays given out by uranium salts and more generally to all radioactive substances. The accurate measure of ionization with a very sensible electrometer became, in the hands of Mme. and Pierre Curie, the talisman that opened a new world to them; it enabled them to separate the marvellous radium, the radioactivity of which is about five million times that of uranium.

Such an accurate method, the instrument of that splendid discovery, was first applied in 1908 by the French physicist Villard to the dosage in radiotherapy. Villard defines the quantity unit of rays as "that quantity which by ionization produces one electrostatic unit per cubic centimeter of air, in normal conditions of temperature and pressure." Unhappily the very cleverly constructed apparatus of Villard has never been manufactured.

His attempt was taken up successfully some years later in Germany by Kroenig and Fried-

rich in the University of Freiburg in Brisgau and also by Seitz and Wintz in the University of Erlangen.

Both these schools started from the same point, the ionometric method, but diverged into very different ways. Kroenig and Friedrich adopt, under the name *e* the unit chosen by Villard. They applied this physical unit to the measure of the dose causing skin erythema, equal to 170 *e*, also to the measure of various therapeutic doses, also expressed in *e* units.

Seitz and Wintz, like their colleagues, also applied the ionometric method to the measure of the dose provoking skin erythema, but did not express their results in physical units; they say only that it corresponds to thirty-five discharges of their iontoquantimeter, different from Kroenig and Friedrich's instrument. The erythema dose thus determined was used by them, under the name of *Hauteinbeitdosis* or in short H E D as a biological unit, taking the place of all the physical units previously employed. They try to express in centesimal fractions of this H E D various therapeutic doses, for instance *Kastrationdosis, Karcinomdosis, Sarkomdosis, Tuberkulosedosis,* and others. Without going into the warmly contested question of the Seitz and Wintz therapeutic doses, it is advisable to study here the value of the fundamental unit H E D upon which they make all the others depend.

Numerous and precise chemical researches have shown that the skin radiosensibility varies within very wide limits. However these variations would be practically of no importance with respect to dosage if all the radiotherapists had adopted as an erythema dose the same average value, in a word, if the H E D of the one were exactly the H E D of the other.

In this respect, the researches of Bachem in 1922, the more recent researches of Holthusen and above all those of Grebe and Martius have thrown full light on the question.

Grebe and Martius' inquiry about the different values of the biological units named H E D has been extended to 14 institutions and concerns 27 different types of apparatus. They used the ionometric method with Wulff two wire electrometer, strictly graduated in German roentgen units at the Berlin Reichanstalt. They have summarized their results in a table. In the second column of this table, the German roentgen units have been converted into French roentgen units by Kaplan of New York. The definition of both units will be given later on.

The table proves the extraordinary multiplicity of the H E D which differs not only in various universities, but in the same university, from one clinic to another, and, even in the same clinic, from one apparatus to another. It shows chiefly the very great difference between the smallest H E D, in Marburg and the greatest H E D in Giessen. The ratio between them is exactly as 1 to 3.9 the second one is about four times greater than the first one.

It is unnecessary to point out the bad results of this excessive difference between the various H E D and the resulting therapeutic doses.

The choice of skin erythema as a biological unit was indeed very unfortunate. Would not other tests such as the eggs of *Ascaris megalocepbalo* used by Perthes and by Holthusen or the seeds of *Vicia faba equina* so happily employed by Jüngling be better biological units than the human skin? It is doubtful. These tests are very good for experimental researches in comparative radiobiology, but like every living being, they never possess the constancy of the purely physico-chemical phenomena.

We must now come back to the way formerly traced by Holzknecht, Sabouraud and Noiré, Kienböck, Guilleminot, Bordier, Fürstenau, and others. It is necessary to express not in biological but in physical units the different doses in the treatment of various diseases. It is a general necessity, for roentgenotherapy as for any other therapeutic method, for imponderous quantities of radiant energy as weighty medicaments. In Germany only, under the influence of the otherwise so important researches of Seitz and Wintz, this necessity has been sometimes forgotten, but is now again recognised.

It seems now the proper time to determine upon a physical unit of dosage that may be common to all radiotherapists of all countries. The first point to fix is which is, for physicians, the best method for measuring the radiation intensity. Undoubtedly it is the ionometric method exclusively used by physicists and on which is based all radioactive science.

Let me recall the fundamental advantages of the ionometric measures compared to the coloration measures of any chemical test. The personal equation which plays a part in colorimetric valuations does not exist in the observation of the movement of a needle or a shadow on graduated scale. The various shades of a bariumplatinocyanid tablet or of a silver bromid paper are proportional to the quantity of rays absorbed by the living tissues but only in respect to a particular quality of rays and not to rays of very different penetrative power. For instance, with the use of more and more penetrating and filtered rays, the erythema dose has been successively measured by 5 H, then by 10 H and at last by 20 H. On the contrary, according to Friedrich, the ratio between

the absorption in the air of an ionometric chamber and the absorption in water, about equal to that in soft parts of the body, is constant for all roentgen rays, whatever may be their penetrative power, as well as for the gamma rays of radium. In fine, the ionometric method permits more readily than others the measurement not only of the superficial dose given to the skin during the exposure, but also of the dose given in depth, either directly and accurately in the natural cavities or indirectly and approximately by means of a water phantom.

The weak point of this method is the difficult comparison between the various ionization chambers and electroscopes or electrometers; in a word the difficult standardization of the measuring apparatus.

It is now the moment to characterize the two very different units that, in Germany and in France are designated under the same name, as roentgen units.

Four years ago, in 1921, Dr. Salomon, at that time my assistant in the roentgenotherapy department of the *bôspital Saint Antoine*, while presenting to the *Academie des Sciences* and to the *Academie de médecine de Paris* a new ionometer, very simple, strong and easy to handle, described a *Roentgen unit* and designated it by the letter R, a unit of quantity thus defined: "The amount of roentgen rays producing the same ionization as one gram of radium element, distant 2 centimeters from the ionization chamber, in the same axis, after filtration through 0.5 millimeters of platinum." This new unit, adopted in France and other countries by many radiotherapists is now generally used.

Three years later, the German Roentgen Society adopted another unit, presented by the physicist Behnken, which is based on the eloctrostatic unit as well as that first chosen in 1908 by Villard and afterwards used by Friedrich under the designation *e* and by Duane under the designation E. The unit of Behnken studied in an ionization chamber containing air is more accurate than the previous ones. His definition was as follows: "The amount of roentgen rays irradiating one cubic centimeter of air, at 18°C., under 760 millimeters of mercury, all liberated electrons being used and all action from ionization chamber cells being eliminated as to produce such a degree of conductivity that the quantity of electricity measured by saturation current equals one electrostatic unit. This new unit is called a roentgen unit and is designated by the letter R."

The standardization of the dosimeters is very different whether based on the extremely delicate measure of one electrostatic unit under the conditions fixed by Behnken or upon a comparison with a constant radiation source such as radium. Behnken's unit standardization is surrounded by impediments and difficulties while Salomon's is relatively simple and easy since it uses a natural substance, identical in London, New York, and Berlin. With a few milligrams of radium, the constructers and even the radiotherapists of all countries can themselves with a little care, standardize their measuring instruments. It is with the help of radium that Friedrich, Grebe and Martius, during their researches carefully verified the constancy of their apparatus. It is also with the help of radium that the standardization committee of the German roentgen society recommends to check the constancy of apparatus graduated in Behnken units.

For practice of roentgenotherapy, it is at least necessary to know exactly the ratio between the different units used in the different countries. We know that:

(German) (French)
1 Behnken R = 2.25 Solomon R

The conversion of one unit into the other is no more difficult than is the conversion of inches into centimeters. Nevertheless the international unification of dosage in roentgenotherapy would be extremely preferable. The progress of roentgenotherapy largely depends upon that unification. Many problems are still to be solved, their solution requiring above all precise measures both in quality and quantity.

That is why, at the opening of this International Congress, I call on the radiotherapists of all countries, first, to admit the necessity of standardization for dosage measurement and second, to elect an international committee for the study of this very important question. It is probably impossible to resolve it during the short time of a congress but motions seriously studied and elaborated by a competent committee might be proposed at the next congress for general approval.

The International Committee, the nomination of which I wish, ought to be composed of both physicians and physicists, the former needing certainly the help of the latter but the physician's point of view will not be necessarily that of the physicist's.

Physicists are never satisfied with the precision of their measures and always try to improve it. They, for instance, can measure heat to the thousandth of a degree. They are right in doing so, but we are not wrong when we are satisfied in taking the temperature of

our febrile patients only to a tenth of a degree. The precision that we require is essentially a practical precision.

Our aim is to reproduce as exactly as possible the conditions of treatment given by one of our colleagues on this or on the other side of the Channel or of the Atlantic Ocean. It is necessary to know exactly as well the quality of the radiation used as the quantity of the dose given.

This modest aim is for us as physicians, much more important than the aim of the physicists who are looking towards the determination of the quantity of radiant energy absorbed by a cubic centimeter of given substance, but who will certainly never be able to tell us the quantity of radiant energy absorbed by each living cell and still less the fraction transformed into biological reaction.

Starting from this point of view, the subordination of scientific rigour to the necessities of practice, I ask you earnestly, my dear colleagues, to study the question of international dosage standardization in radiotherapy.

BARCLAY, A. E. The gentle art of palpation.

Roentgenoscopic palpation is more than the prodding and pushing of the shadowed outline of the intestines with a wooden spoon or the hand sheathed in an opaque rubber glove. It is an art that requires experience and practice. It can be done with safety with the bare hand if the observer knows the dangers of carelessness and makes an inviolable rule that under no circumstances will he allow his palpating hand to come within the illuminated area.

By combining the sense of sight with the sense of touch we can get a great deal of information that cannot be obtained in any other way. Using the first mouthful of opaque food all the folds of the mucuous membrane can be combed out, the craters of ulcers filled and the presence of undue fixation noted. By using both hands it is often possible to block up the second part of the duodenum with the left hand while the cap is distended by pressing food into it from the stomach with the right. By maintaining a constant pressure over a resistant part of the abdomen we can detect whether this is or is not due to the tumor within the abdomen if we instruct the patient to take a deep breath; if it is a tumor within the abdomen we can feel it move under the wall and a good idea can be obtained as to its size and fixation.

A systematic and routine examination by palpation will give greatly added accuracy of the early and less evident pathological changes in the alimentary tract. It is not, however, an excuse for inefficient roentgenographic technique; plates should be taken, or at any rate attempted, to show those things which we can discover only by the palpation method.

FORSSELL, G. The motor mechanism of the digestive mucous membrane.

The author has in several publications expressed the opinion that the folding of the mucous membrane in the digestive canal is regulated through active movements of the mucous membrane itself, and that opinion has through additional observations been further verified.

Gunn and Underhill (1915) and King and Arnold (1922) have published observations on the active movements of the digestive mucous membrane in cat and dog.

G. Thorell (1924) has contrived in a great number of cases graphically to show that the surviving muscularis mucosa of man and of warm- and cold-blooded animals has the capacity of making rhythmical movements of its own, and in combination with the nervous elements in a typical way responds to different stimuli, such as physostigmin, chloride of barium, papaverin and nicotine.

With a new series of roentgenograms the author confirms his previous observations regarding extensive variations of the mucous membrane relief in the same region of the digestive canal. He demonstrates on anatomical preparations from man and animals the enormously varying pictures of the mucous membrane relief. No permanent mucous membrane folds exist in the human digestive tract. The valves of Kerkring are also changeable and analogous to other folds of the living small intestines in man and animals. Through numerous roentgen pictures and anatomical preparations the author demonstrates that the typical pictures of the living intestines correspond to a really different relief of the mucous membrane and that they are not produced only through different charges of a constant lumen, as many authors supppose.

Through observations of intestinal fistulae in man and of the isolated mucous membrane in man and animals the author has been able to prove actively regulated movements of the mucous membrane, and has in histological preparations demonstrated the phenomena of contraction of the nonstriated muscular tissue described by A. Mueller. These pictures of contraction of the muscularis mucosa appear as well in the stomach as in the small intestines and in the colon. Great variation in the thickness of the submucosa is observed in histological preparations as well as in macroscopical sections of anatomical preparations, indicating

that the formation of the folds to a very large extent is regulated through displacement of the mucosa by different amounts of liquid in the vascular system of the submucosa.

The formation of the folds in the mucous membrane is evidently influenced partly through contraction of the muscularis propria and partly through pressure of the contents of the lumen. But the organized and typical form of the mucous membrane relief is evidently regulated through hydrodynamic and muscular forces of the motor mechanism of the mucous membrane itself. The formations of the mucous membrane have great influence not only upon the form of the lumen but also on the consistence and shape of the digesting and absorbing surface. Different formations of the mucous membrane which appear in pathological conditions are reasonably explained through active movements of the mucous membrane as for instance certain phenomena in ulcus ventriculi and ulcus duodeni. Hans Hellmer has recently described typical variations of the mucous membrane relief in gastro-entero-anastomosis, proving that the formation of the folds changes when the functional conditions become altered and Alessandro Valenti (1924) has proved that pilocarpin administered *per os* increases the relief of the gastric mucosa.

By stenosis and other disturbances of the mechanism of movement manifold variations in the formation of the mucous membrane are observed.

Evidences are accumulating to prove the importance of the movements of the mucous membrane to the mechanical regulation of normal and pathological digestion.

HARRIS, H. A. The function of the radiographic department in the Institute of Anatomy, University College, London.

The function of the Radiographic Department in the Institute of Anatomy is best indicated by a sketch of our activities during the past session. The routine work of the students is not here considered.

1. *Normal Growth and Development.* The routine examination of all abortions, miscarriages and still-born children is throwing valuable light on the problems of skeletal development, ossification, dentition, and differences of sex and race. The skull, vertebral column and thorax yield many new facts. The difficulties of labour can often be explained in terms of the advanced ossification of the full term fetus, especially as regards the skull, coracoid, and humeral head. Sex differences in the pelvis and thorax are demonstrable at an early age. Cervical ribs are much more frequent in the fetus than in the adult. In fact, clinical cervical rib is a failure of the normal process of absorption of the normal fetal cervical rib. The growth of the long bones is illustrated by a case in which certain transverse striations have confirmed Hunter's classical "lead shot" experiment. Growth in length of the long bones is entirely epiphyseal and there is no interstitial growth in the shaft.

2. *Normal Physiology.* In conjunction with Professor Barcroft and his coworkers at Cambridge the volume changes of the spleen in exercise, hemorrhage and co-poisoning, have been studied. Michel's clips are fixed to the margins and poles of the spleen and two roentgenograms are taken in the lateral and anteroposterior plane with an exposure of 1/8th of a second, the two exposures requiring an interval of half a second. It has been shown that the resting spleen contains an extravascular reservoir of blood which can be thrown into the circulation whenever an extra call is made upon the animal economy.

3. *Phonetics, Anthropology and Errors of Speech.* In association with Mr. Stephen Jones of the Department of Phonetics, roentgenograms have been taken of the skull with one fine metal chain lying on the dorsum of the tongue and another lying on the floor of the nasal cavity and soft palate. The position of the soft palate, tongue, epiglottis, hyoid and larynx are registered during the phonation of various sounds. Individual, dialectic and racial differences are shown and the method opens up a new field in phonetics and anthropology.

4. *Comparative Anatomy.* New facts in development are being ascertained by routine examination of pregnant uteri of mammals and primates in particular. Skull development can be traced in the embryos and the labor and expense of histological section and wax reconstruction considerably reduced. In collaboration with Dr. Johann Schmidt of Copenhagen, an exhaustive study of the skeletal characters of Atlantic and Pacific eels has been carried out. Identification of new species of reptiles has been possible on several occasions.

5. *Teratology.* The obstetric unit and children's clinic of the hospital furnish material for the study of congenital factors in deformities such as cleft palate, spina bifida and polydactylism.

6. *Gross Morbid Anatomy.* Special attention is paid to the diseases of bone in conjunction with the biological and pathological departments. Rickets, scurvy, fetal and adult dystrophies, such as achondroplasia and Paget's disease, and the dissemination of secondary tumors are being studied.

7. *Antenatal Mortality and Sex Ratios.* The effect of radiation of mice and rats on the subsequent litters is subjected to minute statistical examination by Dr. Parkes, of the Physiology Department, and disturbance in the proportion of the sexes is being observed in large groups of experimental animals.

SOSMAN, MERRILL C. Aneurysms of the internal carotid and tumors at the base of the brain.

Material. 1161 cases of verified brain tumors.

12 per cent of 470 gliomas show in roentgenograms.

50 per cent of 135 meningiomas show in roentgenograms.

70 per cent of 54 suprasellar cysts show in roentgenograms.

Most of the adenomas, but practically none of the neurinomas or granulomas show in roentgenograms.

Characteristic changes in each type are briefly described and illustrated, for comparison with

10 confirmed cases of aneurysm and
10 probable cases.

These have a typical history, but the physical findings may be duplicated by any tumor in the same location.

They can be visualized in the roentgenogram in about 25 per cent of cases, depending upon etiology, which is discussed, with mention of pathology, treatment and prognosis.

STEWART, WILLIAM H. The time factor in the disappearance of roentgenographic evidence of fracture of the skull.

Twenty-seven cases of fracture of the skull have been followed up and re-examined at periods of from three months to seven years after the original injury; many of them have had examinations once or twice a year until all roentgen-ray evidence has disappeared.

An attempt is made to demonstrate the different methods of healing and the many terminal results.

The deductions are that disappearance of the fracture lines depends largely upon the age of the patient, his healing powers and the character of the injury.

Simple fissured fractures of the vault, particularly in children, often disappear within six months. In adults the time is prolonged, some remaining as long as three years.

In the occipital region both in children and adults the evidence is likely to remain longer, probably from three to five years.

Some fissured fractures of the vault, especially in adults, tend to heal to a certain point and then a condensing osteitis appears at the edges of the fracture, which, in my opinion, will remain permanent.

If there has been much separation of the fragments the evidence, even in children, can be detected for a variable length of time. It certainly does not disappear within three years.

Comminuted or depressed fractures, especially if there has been unrelieved undersliding of the fragments, cause a permanent defect. If relieved, new bone may replace the missing segments but there is likely to be a vacant area present which remains indefinitely.

HOLMES, G. W. Roentgen-ray observations in aortic regurgitation.

1. The literature on the diagnosis of aortic regurgitation in relation to its etiology is reviewed.

2. A method of study of the heart and aorta by means of roentgen-rays is presented.

3. Thirty-four cases of aortic regurgitation of various etiological factors are discussed, especial emphasis being placed upon the roentgen-ray findings in these cases.

4. In this series, it is proved that the roentgen-ray studies were of distinct value, though not infallible, in the differentiation of aortic regurgitation of syphilitic, rheumatic, arteriosclerotic and hypertensive origins. The salient points of differentiation are discussed.

EASTMOND, CHARLES. Chronic infection of the gastrointestinal tract; its roentgen manifestations.

Interest in gastrointestinal roentgenology has been confined practically to the detection of ulcer, new growth, disease of the gall-bladder or of the appendix. This interest has been maintained largely because of the surgical possibilities of treatment. Careful study of the gastrointestinal films will reveal many associated lesions which have been hitherto overlooked. These lesions manifest themselves as minor changes producing stiffening with consequent diminished elasticity and contractures of the various portions of the tract. The sites of election are the prepyloric end of the stomach—especially the lesser curvature—the duodenal cap, the second portion of the duodenum, the terminal ileum, cecum and iliac portion of the colon. These changes, visible by roentgen examination, are dependent upon local inflammatory processes; and the appearances will vary from the acute, congestive stage to that of ultimate infiltration and fibrosis. No attempt is made to discredit the older diagnoses, but rather to add the recognition of these further changes as a cause of

persistence of symptoms after the removal of the offending lesions.

PIERSON, J. W. The localization of brain tumors by ventriculography.

The early diagnosis and localization of brain tumors is a very important but an extremely difficult procedure. By the precise localization of the tumor the patient escapes many dangerous exploratory operations and his chances of a complete recovery are greatly improved. Many brain tumors which cannot be localized either by their neurological manifestations or the routine roentgen-ray examination can be localized by the effects which they produce upon the ventricles. Changes in the size, shape and position of the ventricles, caused by the presence of a brain tumor may be registered in a roentgenogram by the withdrawal of cerebrospinal fluid from the ventricles and the substitution of air. The correct interpretation of the changes in the ventricles as shown in the roentgenogram makes possible the precise localization of the tumor, but the interpretation of the roentgenograms is difficult and requires a large experience and careful study.

The procedure is dangerous and complicated but in competent hands it should not be nearly so dangerous as an exploratory craniotomy and it frequently yields more information than the latter operation. The writer has seen three deaths only which occurred among the first fifty of a series of over five hundred cases.

CARMAN, RUSSELL D. Cholecystography in its application to the diagnosis of cholecystic disease.

Carman reported the results from the examination of more than 1100 patients. The sodium salts of tetrabromphenolphthalein and tetraiodophenolphthalein were each used, both orally and intravenously, and the four series were described separately.

Diagnostic results from all these methods were practically the same. More than 800 patients were given the bromine salt orally, and 140 of these have been operated on. In 71 cases the gall-bladder contained stones, and all but 5 of these showed cholecystographic signs of disease. A definite cholecystitis without stones was found in 33 cases, and 27 of these cases responded abnormally to the test. Among 17 cases in which the gall-bladder showed only traces of disease, the test was positive in 7 and negative in 10. The gall-bladder was explored in 19 cases during operation for other lesions, and was accounted to be normal; in 16 of them the dye test had been negative.

Intravenous administration of the bromine salt was frequently attended by systemic reactions, sometimes severe. With the iodine salt there were no reactions. With either drug the administrative technique requires careful execution, and is time consuming.

Oral administration of the iodine salt was rather often followed by nausea, vomiting or purgation. These inconveniences occurred only occasionally from the bromine salt given orally.

REINBERG, SAM. A. Roentgen-ray studies on the physiology and pathology of the tracheobronchial tree.

With the purpose of examining the defense mechanism of the tracheobronchial tree, the author, in collaboration with Dr. I. B. Kaplan, has introduced opaque substances into the air passages of different animals and of man. The experiments have shown that there exists one most important mechanism for expelling from the lung foreign matter and secretions—a real active peristalsis of the tracheobronchial musculature, besides the well-known cough reflex and ciliary activity.

The following movements have been observed: (1) longitudinal contractions—the tracheal rings in some point approach one another, while in points higher and lower the distance between two rings increases; (2) circular contractions—the lumen of the trachea or bronchus becomes narrow, usually synchronous with the shortening. The tube therefore assumes a rosary or bamboostick appearance, and (3) wavy contractions of the entire tube,—a bronchus bends like a bow and this bow is slowly drawn upwards. This has been analyzed in the trachea of the goose, and in numerous instances shown on the screen and plates concerning the human tracheobronchial tree.

Secretions and bismuth mixture in the peripheral areas of the bronchial tree do not excite the cough reflex. The patient remains quiet, while the alveolar tissue and the bronchi of the fifth, fourth and third orders are filled with bismuth; the cough comes on only when the intruding mixture ascends to the larger bronchi and the trachea. It is not the ciliary action which forces up the mixture; the chief burden is borne by the peristaltic wave.

Sometimes one remote lobe or an apex is injected by the splashing of the mixture, expelled by coughing from another part of the lung.

In gangrene and abscess the peristalsis seems to be more energetic than in the normal. Bronchiectasis diminishes the peristaltic activity. The ectatic cavities themselves are utterly

tolerant to the opaque substance—the mixture resting in the dilatations during weeks and even months, while from the uninvolved bronchi the bismuth disappears very soon after the injection. There have never been observed proper movements of the cavity walls; the dilatations do not change actively their lumen. The cough reflex in bronchiectatic patients is excited only when, in consequence of changes of the position, or compression in deep respiration, the mixture is passing from a cavity into a large normal bronchus. Bronchiectasis is characterized by a considerable deficiency of the excretory function caused by the lesion of the walls. This lesion, involving especially the muscles and elastic armature, is a primary process, the pathological changes in the mucosa, the pulmonary tissue and the pleura being secondary.

Many drugs act probably by influence on the muscles of the bronchi, as, for instance, opium and its derivatives paralyze peristalsis, as it does in the digestive tract.

DAVIES, H. MORRISTON. The importance of radiology in connection with intrathoracic surgery.

The thorax and the skull are alike in that they both contain organs which are inaccessible to palpation and which are subject to peculiar mechanical forces. Diagnosis is often not easy and localization may be very difficult. Operative measures for the purpose of establishing the diagnosis are—unlike exploratory laparotomy—fraught with such grave risks as to be in many cases inadvisable.

In thoracic surgery accurate diagnosis and localization are vitally necessary as a preliminary to treatment. The clinical methods of examination are invaluable, but they are incomplete; they are not fine enough, not sufficiently discriminating, not equally applicable to superficial and deep lesions, and are too dependent on the perceptive capacity of the examiner, and his power of eliciting the signs, and then of interpreting them. Roentgenology is not a substitute for clinical examination but both in the matter of diagnosis and during the course of treatment, it is such a valuable adjunct that, in my opinion, treatment should not be decided on, nor carried out unless this method of checking, controlling and correcting the clinical findings has been made use of, excepting always in those cases which are out of reach of roentgen-ray apparatus or in which the disease is of too acute or of too serious a nature to allow of the conveyance of the patient to the apparatus.

The value of the roentgenoscopic evidence is incontestable. Unless and until clinical evidence becomes infallible, roentgenoscopic investigations must form part of the routine examination of the chest, if such examination is to be regarded as adequate. Without it no reasoned opinion on the extent of the disease—even on the character of the disease—or on the future prospects can be given, and no line of treatment laid down. The roentgen rays will not infrequently show greater changes than hand and ear detect or lead one to suspect; and operative procedures which one may have been led to contemplate after clinical examination may be vetoed by the changes in the opposite lung revealed in the film. Roentgenology is of equal importance during and after operative measures. It is the most efficient means of checking one's results and of appreciating the immediate postoperative changes, and so of gauging the probable effects of such treatment.

During the course of artificial pneumothorax treatment, once the lung is separated from the chest wall, it is extremely hard to say what is the extent of the collapse; that is to say, whether the lung is collapsed against the mediastinum or is held out in one or more places by a single or by multiple adhesions. Further, if adhesions are present, it is most important to know the character of those adhesions and the condition of the lung at the point of attachment of the band or bands. As a means of obtaining answers to these questions, even roentgenology is not always satisfactory since the view obtained is limited to certain planes only. One cannot see the adhesion from above nor from below, nor even properly from the side. For this reason roentgenology may fail to give very important and necessary information; such information can however be obtained by the thoracoscope.

In many cases when the lung has been collapsed for some time (weeks or months), it tends to creep out again. This process can be much more accurately followed by the help of the roentgen-rays but even this means will often leave one uncertain.

During the production and maintenance of an artificial pneumothorax effusions are apt to occur. Some of these are too small to be detected except by means of the roentgen-rays. The recognition of such an effusion may be of value in accounting for a rise of temperature which otherwise cannot be explained.

Roentgenological examinations are an absolute necessity when doing a bilateral pneumothorax. The extent of the collapse on the two sides has to be watched with the greatest of care.

Phrenicotomy used to be practised with the object of paralyzing one dome of the diaphragm, to obtain local collapse in basal cases

of tuberculosis and bronchiectasis. It was frequently found, however, that either no paralysis had been affected or that it was only partial or temporary. The work of Felix, which demonstrated the presence of an accessory phrenic nerve in about 25 per cent of individuals, led to the substitution of division by evulsion i.e. the plucking out of the whole length of the nerve from the neck down to the fibres of insertion into the diaphragm. The frequent failure of simple division of the phrenic as compared with the success which attends evulsion—the raising of the diaphragm into the thorax, the paralysis of the dome, the immobility during quiet respiration, the paradoxical movements which accompany deep respiration have all be discovered and recorded with certainty by roentgenological examinations. This has been the means moreover of showing not only the altered position of the muscle but, in addition, the extent of the collapse of the base of the lung which accompanies it. The height to which the dome rises after paralysis varies from 2 to 4 cm. on the left side, and 4 to 8 cm. on the right.

Illustrations are shown of one of the twelve patients whose phrenic nerve the author had evulsed on one or the other side. They are of particular interest to roentgenologists. The man was wounded by shrapnel in the neck in 1918. The right recurrent laryngeal nerve was divided and the body of the 4th dorsal vertebra injured. Drainage tubes were inserted through his neck from front to back and down the posterior mediastinum. His wound healed, but he developed bronchiectasis of the right lower lobe. He was sent to me eight months ago on account of this. He had an incessant cough, was producing some 4 ounces of fetid sputum in the twenty-four hours and had dyspnea. Roentgen examination failed to show any cause for his bronchiectasis—as had been the case before both in Netley and in London. Not satisfied, I took him to Ruthin Castle where Mr. Marxer examined him. By raising the tube almost to the level of the man's head he was able to demonstrate the foreign bodies at the base of the lung.

To have attempted to remove the foreign bodies would have meant opening septic bronchioles. I decided therefore to try first the effect of paralyzing the dome of the diaphgram by evulsing the phrenic nerve. The considerable rise of the dome as a result of the paralysis and the collapse of the base of the lung is illustrated. This simple treatment has sufficed. The man has been completely freed of his cough, of his sputum and of his dyspnea.

When one considers further the various problems offered by gunshot wounds and the localization of metal fragments; of effusions and empyemas, which may be pleural, interlobar or mediastinal; of spontaneous and traumatic pneumothorax; of abscess and gangrene; of intra- and extra-pulmonary tumors, it must be obvious that the roentgenological examination is an essential adjunct to the other methods of investigation both for the physician and the surgeon.

JORDAN, A. C. Peribronchial phthisis.

It is thirteen years since I described "peribronchial phthisis." Certain misconceptions are still prevalent.

A roentgenologist should never report "chest is normal;" he should only report that "it shows the usual fibrous and glandular shadows seen in all healthy persons" and that "these shadows do not indicate active disease of the lungs." The roentgenologist must recognize and explain the nature and origin of these shadows.

Catarrh of the air-tubes arises in the course of ordinary "colds." In catarrh, epitheliod cells lining pulmonary alveoli are shed into the lumen of the tubules, and micrococci pass through into the peribronchial tissues where they become surrounded by clusters of leucocytes. These clusters give rise to the fine mottling seen in the roentgenograms in cases of pulmonary disease. The lymphatic glands at the roots enlarge in carrying out their normal function of dealing with microbic poisons draining to them from the peribronchial area .

Healing may take place (*a*) with complete resolution, or (*b*) with formation of fibrous tissue around the air-tubes and around the root-glands. If the disease progresses, the mottle areas coalesce into blotches and the glands at the roots enlarge still more.

Peribronchial mottling is not always tuberculous; it is *never* tuberculous at first; it is micrococcal. The tubercle bacillus gains a footing after the tissues have broken down under the strain of the micrococcal invasion. Similarly a "white swelling" of the knee is micrococcal at first, and is readily curable by a vaccine, provided all septic foci (in the intestines and elsewhere) can be discovered and cleared up. If this is not done the tubercle bacillus gains a footing after the tissues have become badly impaired by the chronic micrococcal infection.

The precise moment of this occurrence cannot be determined by any clinical or roentgenographic sign, though in its established stages it is easily recognized.

The practical outcome is that every case should be treated as though it were of toxemic

origin, and as though it were already tuberculous. If purely toxemic it will heal quickly when the toxemia has been rectified. If already tuberculous, healing will be slower but no less sure, provided the disease has not taken too firm a hold.

JAQUFROD. The radiographic control of the healing of tuberculous lesions of the lung.

No one today doubts the possibility of natural and spontaneous healing in pulmonary tuberculosis. Former tuberculous patients, now cured, are to be found in every walk of life and in every occupation. Unfortunately, these cases are still comparatively rare, considering the very large numbers who suffer from this disease.

I do not intend to discuss the reasons for this, and still less to give statistics of cures, but I shall endeavor to show that these cures can be verified by roentgenography.

In the matter of healing the roentgenoscopic records are of the utmost importance. They are really equivalent to a bioscope on which can be shown objectively, at any time, not only the stage and extent of the lesion, but also, in the clearest possible manner, the different stages of the process of healing.

These processes fall under three different categories: (1) Healing by resolution; all trace signs of the diseased focus disappear completely from the roentgenogram, and the lung regains its former normal appearance; (2) sometimes resolution is only partial; the diseased area is converted into cicatricial tissue which shows on the plate. Its shadow can, however, be distinguished from those thrown on former plates by the active process; (3) in some cases healing is brought about by fibrous transformation of the whole lung, accompanied by retraction of that organ and considerable displacement of the heart and mediastinum toward the affected side.

Today, we are no longer justified in pronouncing pulmonary tuberculosis as cured unless a series of roentgenograms, taken from the onset of the illness to the cessation of treatment, can be referred to. These would also constitute an efficient control on the efficacy of the numerous remedies which are lauded as cures for tuberculosis. The roentgenographic findings would also be a valuable aid in discovering a *real* specific for tuberculosis.

SICARD, J. A., and FORESTIER, J. General method of radiological exploration with lipiodol.

Lipiodol is a definite chemical compound in which iodine is combined with a vegetable oil in the proportion of 40 per cent. It is very opaque to roentgen rays and remarkably tolerated in all cavities or tissues of the body. It has been used for four years by the authors who have succeeded in settling the following applications.

(1) Experimental applications—Intravascular injections to animals and man. Study of the circulation, of the capillary net-works, and fat embolism.

(2) Applications of clinical interest.

Stomach—Capsules in gelatin for the measuring of the secretory activity.

Lacrymal ducts—Obstruction, diverticula, fistulas and abscesses.

Face sinuses—Sinusitis and abscesses.

Urethra—Strictures, diverticula, prostatitis.

Uterus and fallopian tubes—Fistulas.

Ventricles—Hydrocephalus and cerebral tumors.

(3) Applications of new interest.

Cold abscesses—Search after focus—Pott's disease.

Respiratory tract—Deviations, compressions, abscesses, bronchiectasis, tuberculous cavities, cysts.

Subdural space—Pott's disease, vertebral cancer, fractures of the spine and spina bifida.

Sub-arachnoid space—Localization of compressions of the spinal cord, abscesses, fractures and meningitis. For these last applications a dilution of lipiodol, called "ascending lipiodol" may be injected by lumbar puncture.

Out of over 5000 injections made, no severe or fatal accident was ever noticed.

CORDUA, RUDOLF. The morphology of the collum carcinomata of the uterus as a basis for the judgment of the sensibility to rays.

In destroying the malignant tumor cells by rays of short wave-length the direct influence on these cells is the main reliance. We already know something about the sensibility of the different malignant tumors to the effect of rays, therefore the experiment is justified to explore the different forms of carcinomata of the uterus collum in this direction. A clear classification of them is necessary to build upon. As the best known authors who have entered into full particulars of this problem Schottländer and Kermauner as well as Krompecher are mentioned. After a short review of their works the division of Schröder is described more exactly which is founded on the idea of taking as basis for the classification of collum carcinomata the normal ability of differentiation of the Mueller epithelial cell to cylindrical or flat epithelial form. The six following groups are briefly described according to their histological construction:

(1) The nondifferentiated, immature carcinoma.

(2) Carcinomata with the tendency to glandular formation.

(3) Distinct adenocarcinomata.

(4) Immature carcinomata with little tendency to flat epithelial cell formation.

(5) Carcinomata with distinct tendency to flat epithelial cell formation.

(6) Horny flat cell carcinomata.

According to this division 40 carcinomata of the collum, nearly all inoperable (from 1922–1924), which were treated by radium and roentgen rays are given as examples. As the carcinoma was already advanced in most cases, a great many of the patients have already died. The proportion of the still living to the dead ones shows that the more differentiated forms give a better prognosis to the radiation than the less differentiated. It is to be acknowledged that no final conclusion may be drawn from the small number.

At the end a short account is given of the so-far known results. It is recommended to avail oneself of the above mentioned clear classification of the collum carcinomata.

KNOX, ROBERT. A radiological method of investigating heart movement.

A description of certain work which has been proceeding in the roentgenological department of the Cancer Hospital on the investigation of the movements of the heart by the use of roentgen rays with a slit diaphragm and a moving film. Attention was first drawn to this method by Reider and Rosenthal of Munich in 1912, and by Crane in America in 1916; after this the subject seems to have been allowed to lapse for several years, until this opportunity came to investigate it further.

The patient stands with his chest in front of the tube box, which has a lead shield with a horizontal slit in the middle of it, and the film is placed in a moving cassette in a lead diaphragm situated in front of the patient, and so arranged that the right and left edge of the heart appear in the slit; the cassette travels slowly in a vertical direction past the slit so that upon the film there is exposed a continuous image of the moving edge of the heart.

As a result of many experiments it has been found that the best records are obtained with 8 seconds of total exposure, the film moving about 16 inches during that time. The positions are so arranged that the edge of the slit to the left projects clear beyond the heart shadow, or, if the horizontal slit is wide enough to cover the transverse chambers of the heart, the movements of both the left and the right edges may be presented. The resulting image on the film resembles in many respects the tracing obtained by the use of the electrocardiograph.

Practically all that the electrocardiogram shows can be demonstrated by the roentgen-ray record of the heart if a full examination is made of all its borders, and the record has advantages over the electrocardiogram in that it is a faithful record of the actual movements of the pulsating heart.

The film shows a number of outlines which are difficult to interpret. For some time it was not recognized that there were what might be described as primary and secondary lines; the former, which are very pronounced, are obviously the records of the movements of the left ventricle and the right auricle, the ventricular movements, if examined carefully, giving all the information afforded by the electrocardiogram and the pulse tracing, and other information in addition. The secondary lines are more obvious on the left side, where the movement is greater. One wavy line occurs at the point of maximum expansion of the heart in diastole, where the heart edge impinges upon the pericardium, pleura, and adjoining lung substance. Other lines on the right side are similarly caused by the transmitted impulses of heart movement upon a buttress of tissue. By the use of this method it is possible to measure accurately the transverse diameter of the heart in any of the levels of the cardiac shadow, and to obtain information regarding the movements of the various chambers.

In aneurysm of the aorta the method has proved useful for investigating the size of the aneurysm transversely and the character of its pulsation, whether true or transmitted to other structures in its vicinity.

It is believed that a comparison of the various measurements will be of the utmost importance in the investigation of cardiac diseases. The degree of dilatation can be estimated, and also the ability of the heart muscle to deal with the dilatation. The transverse width of the heart can be estimated readily by direct measurement from the tracing if the record of both edges of the heart is on the film, the width of the organ in systole and diastole is equally ascertainable, and the difference between the two gives a rough estimate of the tone of the heart and its contractile power.

It is intended to use the apparatus in the investigation of the movements of the normal aorta, to establish, if possible, the normal range of pulsation of its structure, and to apply the knowledge so obtained to the pulsation in aneurysm of the aorta. Possibly the apparatus may be used also for the investigation of other forms of movement—diaph-

ragm, stomach, duodenum, and colon. One of the chief difficulties has been the inadequacy of the roentgen-ray apparatus to give a record on the film through a thick subject because of the shortness of the exposure. This difficulty has been overcome to some extent by selecting thin patients, in whom it has been possible to get a faint record of the moving edge of the heart. More powerful apparatus is required, and the possession of two or more times the intensity of the moderate power available would permit of the roentgenography of thick subjects at a distance of two meters. Work done at this distance would soon place the apparatus on a sound footing for clinical research.

ERSKINE, ARTHUR W. Efficient and economical filtration.

A comparison of the efficiency of various filter materials was made by plotting the gain in penetration with increasing filter thickness against the loss in surface intensity expressed by the increasing time required to produce a given ionizing effect. The results show that copper is a satisfactory filter.

The limit of economical increase in filter thickness was graphically shown by plotting the increase in penetration against the increase in time required to produce a given ionizing effect at the surface, expressed as multiples of the time required by the unfiltered beam to produce the same effect. Such a limit is reached when enough filter to absorb 80 per cent of the original beam has been added, which is not more than 0.75 cm. of copper for roentgen rays produced at 200 kv., and 0.4 cm. of copper for roentgen rays produced at 140 k.v.

FINZI, N. S. The use of radium in combination with *x*-rays and surgery.

The history of the use of radium combined with surgery, diathermy and roentgen rays is briefly traced.

The development of burying radium tubes was followed by the use of large numbers of needles containing smaller quantities in order to obtain a more homogeneous radiation. It was found that a still more homogeneous radiation could be obtained by means of roentgen rays, but the results were either no better or not so good. It is suggested that the reason for this may possibly be that there is a zone around the radium needle which receives a truly lethal dose and that the absorption of this portion of the tumor renders the outlying parts more susceptible to injury so that a smaller dose of rays suffices to get rid of them.

The author uses a combination of roentgen rays and radium in the treatment of carcinoma of the uterus and also in growths in the mouth and throat, but successful results have also been obtained in the latter situation by the use of diathermy combined with radium or roentgen rays.

The use of surgery to remove portions of the maxilla previous to a radium treatment is not looked upon by the author with favor as it seems doubtful whether the cases of necrosis can be attributed entirely to the radiations; they are probably caused by infective foci in the bones of infection of a radium scar. The use of surgery to remove a portion of a growth is also not approved of. It has no advantage and if the growing edge be given a sufficient dose the central portion of the tumor can be disregarded.

HEYERDAHL, S. A. Actinomycosis faciei and colli treated with radium.

The author reports the clinical history and results of treatment of 21 (17 men and 4 women) cases of actinomycosis faciei and colli, some of these very serious cases, which were treated with radium, at the radium section of the Riks Hospital, Oslo, Norway, in the course of ten years (1913–1923). In all cases the diagnosis was confirmed microscopically. In the case of most of these patients, before radium treatment, one or more incisions of the actinomycotic abscesses were made and at the same time potassium iodide was employed. After the beginning of the radium treatment all other treatment was suspended.

In the great majority of cases gamma rays of radium were employed from concentrated preparations of radium, the radium rays being filtered through 1–2 mm. of lead.

The result of the radium treatment was cure of all the patients, with fine cosmetic results in most cases.

The patients were under observation from 2 to 10 years.

ERNST, EDWIN C., BURROWS, MONTROSE T., JORSTAD, LOUIS H., and LUNSFORD, CHARLES J. Studies on the biological effects of *x*-rays and the employed methods of measuring *x*-ray dosage.

The observations here recorded show that energy production in the organism is derived through the oxidation of food substances by the cell. The energy which is utilized for work is liberated not in the form of heat, but in the form of a chemical substance or substances, the *arcbusia* (S). The transformation of this energy into work is proportional to the concentration of this substance liberated by the cell or the amount of it conserved for the cell. In low concentrations the *arcbusia* (S) has no

effect. In medium concentrations (S_2) it causes the cells to migrate, engorge themselves with fats and proteins. This concentration when localized at one end of the cell is ample for a muscle cell to contract rhythmically or show normal function. In high concentrations (S_3) the cell digests its proteins and fats, grows and divides by mitosis. All higher concentrations (S_4) leads to a digestion of the cells themselves. It is well known that the roentgen ray may not only induce cancer at a point where it has acted repeatedly over a long time or intensely for a short time, but that it may destroy cancers. We have been able to induce cancers by first reducing the circulation to apart with pressure and then introducing an extract containing the *arcbusia*. It has again been shown that when the *arcbusia* (S) is raised to a high enough concentration about the cells it leads to a self-digestion of the cells. The object of our experiments with the roentgen ray was to determine whether these rays act to split off toxic substances or only to raise the value of the growth stimulus in or about the cells.

Previous authors have shown that the ultra-violet rays will prevent rickets. They act apparently also to liberate vitamin A from certain fats and tissues. The true significance of these rays in terms of cell activities was impossible to determine, however, until we were able to reduce the processes of growth and function to more definite physico-chemical terms. In the light of the above facts it has become evident that the action of these rays may be none other than an acceleration of the normal metabolism of the cells with a greater production of *arcbusia* and consequently a greater production of the secondary products of cell metabolism. We have found that the animals on a low vitamin B diet suffered least from toxic doses of this substance. Again it was found in the second experiments that the animals are protected against a vitamin B deficiency by it. In the experiment of the feeding of extracts rich in *arcbusia* it has been shown that they act to replace vitamin B. The quantitative studies of the conditions regulating growth in the cultures have also pointed to a relation between vitamin B and the *arcbusia* or the energy of the cell.

In the light of these facts it becomes evident that it will probably be proven that roentgen rays act only to accelerate the metabolism of the cells with an excess production of the *arcbusia*. It has been shown above that an excess of the *arcbusia* slightly over that necessary for the independent growth of cancer is ample to cause a digestion of the cells. In the tissue culture we have found that a small amount of the *arcbusia* which is contained in an extract of embryonic tissue will lead to a rapid digestion of the cells of a fragment of a malignant sarcoma in the course of twelve hours. In the same manner an extract of cancer destroys actively growing embryonic cells. Ten times that amount of *arcbusia* will scarcely stimulate growth in normal adult cells. It became evident, therefore, that the greater sensitiveness of cancer tissues to roentgen rays is to be related to the greater content of growth stimulus (the *arcbusia*) in the cancerous tissue. The future success of roentgen-ray therapy will be established through more careful quantitative studies of the metabolism of the cells, the proper regulation of the metabolism of the patients and carefully guarded and measured doses of these rays.

GERBER, ISAAC. *X*-ray treatment of pyogenic infections, particularly of the skin.

Application of the roentgen rays to pyogenic infections of the skin has been done for many years, but the value of the method has not penetrated to the general medical public until recently. Textbooks of surgery still ignore the method. Recent papers by Hodges have renewed interest in the method in the United States. Heidenhain and Fried have recently stimulated interest in Germany.

The neglect of the treatment has been due partly to the old fear of roentgen-ray burns, partly to excessive emphasis on the roentgen-ray therapy of malignancy, and partly to the lack of proper explanation of the rationale of the treatment. The best explanation of the effects is based upon the production of a general and a local increase in immunity. The latter is due largely to the effect of the rays upon the leucocytes, producing dissolution. The secondary production of antibodies locally is important.

The roentgen-ray treatment is applicable to cases of furuncle, carbuncle, paronychia, phlegmon with or without lymphangitis, cellulitis, axillary abscess, erysipelas, etc.

Clinically the treatment is followed by very prompt lessening or disappearance of pain, diminution in the local edema and swelling and gradual subsidence of the infection. If treated early enough complete abortion of the disease may be obtained. Infections of longer standing may be converted into one enormous abscess cavity which may rupture spontaneously or may require a slight incision or puncture. In other types with the disappearance of the surface edema, one or more centers of localization will be produced which also may rupture or may require evacuation.

The effects of treatment are better when the abscess remains closed.

The author reports 34 cases of carbuncle and 25 cases of paronchyia.

Deep pyogenic infections may also be materially influenced by roentgen-ray treatment. These conditions include perirenal and perirectal abscesses, deep breast abscesses, inflammatory processes of the female adnexa, osteomyelitis, pyarthrosis, etc. Here the results vary with the type and locus of the infection. Proper surgical control is necessary so that surgical intervention may be carried out at the proper time without delay.

The dosage used is small and varies from 10 per cent to 25 per cent of a skin erythema dose. When treating inflammatory processes we are not concerned with obtaining a large depth dose or obtaining a homogeneous distribution of rays as in the treatment of cancer. The entire method is different from that used in treating malignancy.

The application of small doses of roentgen rays to deep-seated inflammatory processes opens a new field of roentgen-ray therapy, the ultimate results of which may seriously affect all types of surgical treatment.

PFAHLER, GEORGE E. The saturation method in roentgentherapy, as applied to deep seated malignant disease.

The "saturation method" in roentgenotherapy consists in the delivery of an erythema dose into the diseased tissue within a short time, and then maintaining this effect for a certain time by means of additional smaller doses to correspond to the loss in effect during any given period. This loss in effect seems to follow the law of mass reactions. Thus at a certain time when concentration has decreased by one-half, the velocity of loss will have become less by a similar amount, and so on until the residual effect has become negligible. This rate of loss theoretically would represent a logarithmic curve and may be so calculated. There is an interval of time during which the tissues recover from an erythema dose (saturation) and at the end of which this dose may be repeated. On this basis of the saturation method, at the end of one fourth of the interval the residual effect will have decreased by one-half, and 50 per cent might be repeated, bringing the effect again to "saturation," or at the middle of this period 75 per cent of the erythema dose may be repeated. It is still a great problem as to how long such a "saturation" effect can be safely continued. Clinically we believe the method produces better results than any other technique, but at present the method must be used with great caution.

WEBSTER, DOUGLAS, THIERENS, J. P., AND NICHOLAS, F. G. The treatment of fifteen cases of operable carcinoma of the breast.

At the present stage of radiation therapy radiation should not be advised in preference to operation in operable breast cases. But as operable cases were sometimes referred because they had refused operation, or because operation was inadvisable owing to age, bronchitis, heart-disease or other contraindication to a major operation, radiologists should discuss the possible technical methods of irradiation for such cases, and the results of treatment. Dr. Douglas Webster give details of 8 cases treated solely by roentgen rays, 2 with radium insertion and roentgen rays, and 5 with surface applications of half a gram of radium element, and additional roentgen-ray applications. Patients with mastitis and possible early carcinoma were not included in the report. As the cases were mostly recent no detailed conclusions could be drawn as to technique or results, but the interim results suggested that radiation was a suitable alternative to operation in some operable cases; patients should not be told that there is no alternative to operation. In the series there had been 2 deaths, one due to intercurrent disease, and one to the disease, over two years after treatment had been discontinued by the patient. One patient had an abdominal metastasis, after reacting well locally. Three were new roentgen-ray cases, but one of these already showed no sign of disease. One was having treatment for a radium dermatitis, the disease appearing to be arrested. The remaining 8 had been in good general and local condition for some time. There appeared to be no noticeable difference in the results in cases treated by deep roentgen rays or chiefly by radium. Very large quantities of radium were necessary if surface radium technique was to be advanced in any large series of patients with breast cancer. Details of the several cases, and the techniques followed were given; and the question of the diagnosis was referred to and a method for obtaining more accurate knowledge of the histological changes resulting from radiation was suggested.

HANDLEY, SAMPSON. The encirclement method of radium treatment.

The author expressed his belief that radiologists should give more attention to the pathological facts, the understanding of which was necessary to radiological treatment. He referred to three fallacies which vitiate much radiological treatment at the present time.

The first of these is that a lump of malignant tissue is homogeneous throughout and requires therefore uniform radiation throughout its

bulk. Mr. Handley pointed out that such a lump of malignant tissue always tends to degenerate from the center to the circumference. The circumference therefore, owing to this centric degeneration requires a larger dose of radium than the center.

The second fallacy is that the limits of a focus of malignant disease can be mapped out by the clinical methods of inspection and palpation. Every focus of malignant disease is surrounded by a zone in which the apparently healthy tissues are infiltrated with isolated cells. These isolated malignant cells are much more active and dangerous than any cells in the palpable mass. Furthermore beyond the zone of infiltration there might be found a still more widespread extension of the disease by permeation of the lymphatic vessels, *i.e.*, the choking up of the vessels by lines of malignant cells growing along them.

The third fallacy is that a focus of malignant tissue extends equally in all directions. In point of fact infiltration extends along planes of least resistance in the soft cellular tissues. In the case of a subcutaneous lump the plane of extension is in the deeper subcutaneous fat, parallel to the skin. In the case of permeation the plane of extension is the plane of the main lymphatic plexus, *i.e.*, the plane of the deep fascia. This shows that radium tubes should be buried in a ring just outside the palpable edge of the malignant mass and that in dealing with growths arising under the skin they should be placed in the plane of the deep fascia.

There is still another reason why the method of burying tubes in the palpable mass—a method which might be called the "centric method," is inferior to the "encirclement method." The author suggests that if the centric method is used the zone of infiltration would probably receive a small stimulating dose of radiation and in his own experience with the centric method the disappearance of the palpable lump is usually followed by the appearance in the adjoining tissues of fresh palpable nodules. The main primary object should be to arrest the further spread of the disease and this can often be attained only by the encirclement method. Later on, if necessary, the palpable mass can be directly attacked either by a second encirclement with a smaller radius, or by burying tubes in the mass.

WINTZ. Experiences in the irradiation of breast cancer.

Steinthal's classification is adopted. Group I. The tumor is restricted to the breast and can be moved; no infection of axillary or supraclavicular glands. Group II. The tumor has already infiltrated the surrounding region; axillary glands palpable. Group III. Glands in the supraclavicular region palpable and, in some cases, metastases also present.

Clinically cured cases are those which were free from any clinical evidence of disease at the end of three years.

Group	Treated	Cured	Per cent
I	21	20	95.2
II	41	28	68.2
III	44	8	18.1

When the author examines these statistics he finds the results correspond to those obtained in the treatment of carcinoma of the uterus. Carcinoma of the breast must also be treated in the initial stages to obtain the best results. It is not the same thing for the body whether there is a small localized tumor or whether the whole glandular system is already involved. In all of the above cases the diagnosis was confirmed by microscopic examination.

In addition to accurately dosed treatment one must give careful after-treatment to eliminate toxins and support the general constitution.

ZWEIFEL, E. The stimulating dose.

The author believes in a stimulating dose and points out that it has been observed in the treatment of plants and mice. He says that increased bleeding is sometimes observed in menorrhagia when the treatment is given shortly before the expected monthly period. Stimulating effects have also been observed in connection with the healing of fractures. He refers to observations made that tumors are stimulated by a disturbance in vitamins, anaesthesia, operations, removal of sections, traumatism, etc., and therefore radiation may stimulate. He has observed an increase in growth of carcinoma of the uterus following small doses of radium. The author claims that he has observed this stimulation only after small doses of radium and never after large doses.

ZWEIFEL, E. Distant effect of roentgen rays in Basedow's disease.

In the course of treatment of tuberculosis by radiation applied to the spleen and long bones the author has also observed the disappearance of Basedow symptoms. The first effect is a recurrence of the symptoms after about eight days. Treatment is repeated monthly. Then the goiter, the exophthalmos gradually disappears together with all the Basedow symptoms. At the same time the tuberculosis improves, catarrh decreases, appetite improves, weight increases, night sweats disappear and at the end they regain their health.

NEMENOW, M. O. Concerning the theory of the biological effects of roentgen rays.

The author observed in 1910 that the effects observed on tissue was not a specific nor direct one but depended upon the action of the rays upon surrounding tissue. As a result of the action of the roentgen rays, according to the dose, the vitality of cells is disturbed; the cells undergo more rapid change and die more quickly, but the manner of death corresponds to that which would have taken place if no rays had been used. Depending upon the dose, and the sensitivity of the cells the aging process takes place. In other words, the life cycle of the cells is shortened. Therefore the older the cells, the more sensitive will they be to radiation, because they retain less vital energy.

The life of cells is very variable, and what is young for one is old for another, depending upon the total normal life of the particular type of cell. Thirty years is young for an elephant, which normally reaches the age of two hundred, but it would be old for a horse. So too the life of a ganglion cell is as long as the life of the individual while the life of a leucocyte is measured by a few days. The karyokinesis is the death agony of the cell. Based upon this fact, the cell is most sensitive in this stage.

In the study of the effects of leucocytes after radiation, the author found that the younger forms were increased at the cost of the older types. The IV and V classes disappeared almost entirely. The cause of the biological process, under the influence of roentgen rays which leads to the senility of the cells, comes from the interference with metabolism, in the retention of the metabolic products.

KIENBÖCK, R. On radiological differential diagnosis of primary tumors of bones and metastases.

There are four forms of metastases in bone from distantly situated gland tumors (mostly carcinomas, rarely sarcomas). (1) Purely osteolytic metastases; solitary or multiple, from carcinoma of the mammary gland, hypernephroma; (2) osteolytic metastases, with bony shell and trabecule formation, often cystic, very similar to (1), especially from carcinoma of thyroid gland.

In both forms the first pains are caused by incomplete subperiosteal fractures. The tumors are met also in younger persons, and are very often erroneously supposed to be primary tumors—sarcomas of the bones, multiple myelomata or Recklinghausen bone disease.

(3) Irregularly spotted and striated mixed metastases (osteolytic and osteoporotic together); from very different primary tumors.

(4) Purely osteoporotic metastases; in older men from carcinoma of the prostate gland.

These two forms are generally more diffuse in the bones and are often erroneously taken for syphilitic osteomyelitis or Paget's disease.

The mistakes happen especially in cases where the primary tumor cannot be found or is difficult to detect or is inconsiderable. By special roentgen studies the different tumors of bones can be recognized properly.

DE BACKER. Radiotherapy and fistula formation.

Recent improvements in radiotherapeutic technique have led us not to consider as hopeless those cases in which the neoplasm has invaded the wall between natural cavities. *First case:* glandular carcinoma of the rectal ampulla having perforated the posterior vaginal wall, treated by curietherapy; *restitution* of the rectovaginal wall resulted. *Second case:* vesicovaginal fistula provoked by carcinoma of the cervix having invaded the vesicovaginal wall; closed completely after roentgen and curietherapy.

DE BACKER and VAN DE PUTTE. Digestive transit in normal sucklinsg.

The examination of many children less than seven months old permitted us to obtain a true standard of the digestive transit; all these children were healthy and came from normal families. The sucklings were examined in ventral decubitus after absorption of the usual quantity maternal or cow's milk.

We have distinguished two stomach types; generally an orthotonic type, the most common, and a hypertonic type, less frequent than the former. In the orthotonic type the evacuation is quite finished after $4\frac{1}{2}$ hr., in the hypertonic sometimes after $2\frac{1}{2}$ hr. The topography of the duodenum is more or less the same as in adults. The small intestine is first filled in the left part, everything goes then to the right near the cecum; after 5 or 6 hr. the small intestine is empty.

The large intestine has more or less the same type as in adults but the transit is quicker. The food enters the cecum after $2\frac{1}{2}$ or 3 hr., reaches the left colic flexure after 5 or 7 hr., the sigmoid after 8 hr. The whole large intestine is evacuated after 8 or 10 hr.

ALTSCHUL. Temporary relaxation of the diaphragm.

A description is given of a disease picture which occurs rather frequently but has hitherto not been fully recognized. The clinical symptoms are not pronounced and are localized

partly in the thorax (slight cough, respiratory difficulty and palpitation), and partly in the abdomen (distention and feeling of fullness). Roentgenologically, there occurs a temporary relaxation of the diaphragm: that is, in the morning the left diaphragm appears in normal position, while in the afternoon it appears on a higher level than the right. The cause of this peculiar behavior of the diaphragm is a mild fatigue of the phrenic nerve caused by pressure of the adjacent organs, mainly the enlargement of the bronchial lymph glands as a result of tuberculosis. The name suggested by the author to describe this disease picture is "diaphragma molle."

ALTSCHUL. Critical remarks on the problem of dosimetry.

There is not yet in existence a dosimeter which satisfies all practical requirements. The main requirement of the roentgenologist for a useful dosimeter is the ability to read at any time the total amount of radiation administered without interruption of the operation of the machine. Other requirements are physical precision, convenience in size, simplicity in reading, calibration of the instrument against the standard unit, recording of the dose and automatic cut-off when a specified dose has been administered. None of the instruments at present in use satisfy all these demands. The main requirement can be most easily attained if the saturation current (reinforced or not reinforced) is permitted to perform a definite amount of work, as for instance the generation of oxy-hydrogen gas in a voltameter, or the deposition of mercury. If the instrument is calibrated then the amount of radiation can be read off at any time in R units.

REPORT OF THE EIGHTH SESSION OF THE STANDARDIZATION COMMITTEE OF THE GERMAN ROENTGEN SOCIETY AT BONN ON RHINE ON MAY 29, 1925

Present: Mr. Behnken, Government representative of the Physikalisch technische Reichsanstalt (Bureau of Standards).
Professor Friedrich, Freiburg-Berlin.
Professor Grebe, Bonn on Rhine.
Privatdozent Holfelder, Frankfurt am Main.
Professor Holthusen, Hamburg.
Professor Martius, Bonn on Rhine.
Professor Meyer, Bremen.
Dr. Rump, Erlangen, representing Professor Wintz.
Privatdozent Schreuss, Duesseldorf.

The problem of bringing the dosimetry on a uniform base, as taken up by the Standardisation Committee, comprises two principles:

1. To point out and establish a unit of measure physically defined, and to transfer this measure from the standardization center to the different roentgen institutions

2. To bring about relations between the dose measured in this unit for different ray qualities, and its biological effect.

The first problem has to be solved before the second one can be worked upon. Therefore, at first, the Standardization Committee has taken up the first problem and in regard to it has given out the following directions. The solution of the second problem will be the next goal for the committee.

Physical and organisational directions for devising and transferring the measuring unit:

A. *Physical.*

1. The dose unit shall be one "Roentgen" or 1 R, introduced as measuring unit by the German Roentgen Society.

The definition of this unit is as follows: (Villard, Friedrich, Behnken)

The absolute unit of the roentgen ray dose is obtained from that roentgen ray energy which by fully utilizing the secondary electrons produced and by avoiding secondary radiations from the wall of the ionization chamber produces in one c.c. of atmospheric air of 18°C. (64.4 F.) and 760 mm. atmospheric pressure, such a degree of conductivity that the quantity of electricity measured by saturation current equals one electrostatic unit. The dose unit is called one "Roentgen" and is signified by R.

Previous differences in the research work were before the committee and have found their explanation. They will be published in "*Strablentherapie*" by Grebe and Martius.

2. To indicate the dose one must give some data about the quality of the rays. It is recommended to determine for this purpose the weakening of the rays in

copper, for light filtration in aluminum. Measurements of weakening must be carried out only with exclusion of any additional dose produced by scattered radiation and only this way, that the additional filter as compared to the filter in use, is sufficiently small in order not to change the radiation quality much. Application of another equal additional filter, therefore, must yield the same percentual weakening of the radiation. In addition to the data of the quality, spectrographic measurements or sphere gap tests of the high tension, the latter with indication of filtration, are useful.

3. The standardizations are made by the standardization center for the qualities as desired by the roentgenologist who wants to use the instrument. Care must be taken that the resulting data are only used in connection with such qualities as have been ascertained.

4. The standardization of the instruments is performed with the measuring body in air, i.e. under exclusion of any scattering effects from the surroundings, using only the pure primary rays. Also when using the standardization data, the measurements must be performed using the pure primary radiation. By this the intensity of the impinging radiation is obtained without the additional scattered rays coming from the body radiated.

Example: When using a standardized instrument one must proceed as follows to find the time, which is necessary for a given apparatus, to produce upon a body a certain number of R, e.g. 600 R.: An electroscope may have for a certain deflection with a given radiation, a measuring value of 2.5 R. 600 R have to be given upon the skin with a focus skin distance of 23 cm. The standardized instrument is placed free at a convenient distance, e.g. 50 cm. measuring body-focus, and deflects within 10 seconds over the part of scale corresponding to the measuring value. Then a radiation time of 10 seconds corresponds to 2.5 R, or, in 23 cm. $2.5.(50/23)^2$ R = 11.8 R. Therefore 1 R will be obtained at 23 cm. distance within $\frac{10}{11.8}$ seconds equal to 0.85 seconds. If 600 R have to be applied, the time of radiation has to be $0.85 \times 600 = 510$ seconds or 8.5 minutes. This value indicates only the radiation on the surface. On account of the back scattering, however, the skin receives an additional dosage according to the radiation conditions, but which, so far as quality is concerned, is not equal to the primary radiation, and, therefore, at the present time cannot be expressed exactly in R units. The back scattering amounts for instance at 190 kv., 1 mm. of Zn, $^8/_{10}$ cm. portal of entry, approximately 80 per cent (Grebe and Martius), which is to be added to the primary radiation.

In case the standardized instrument is a constant deflection dosimeter (Siemens dosimeter), the measuring value for a certain deflection is indicated in R per seconds. If *e.g.*, the deflection obtained when radiating the free placed measuring body, is 0.25 R per second, 1 R has been given within this distance in 4 seconds. Within 23 cm. therefore, 1 R is obtained in $4.(^{23}/_{50})^2 = 0.85$ seconds. The rest corresponds to the example given above.

5. In using the standardization for a biological test the additional dose caused by the back scattering and, besides, the ray density, the latter expressed in terms of time of radiation is of importance. Therefore, when indicating biological doses, besides the impinging primary radiation in R units and besides the ray quality, the size of field, the focus-skin-distance and the time of the radiation must be given. The standardization committee for the time being refrains from an establishment of the skin unit dose measured in R.

B. *Organization.*

The German Bureau of Standards (Physikalisch-Technische Reichsanstalt) has undertaken to bring into practical use the unit R on the basis of the definitions given above. To this institute are connected different authorized standardization institutes, which are in permanent connection with the above mentioned bureau and which are entitled to make absolute determinations of the R unit, comparing their measurements with those of the bureau of standards. There are authorized standardization institutes just now in the following places:

Berlin, Physikalisch-Technische Reichsanstalt.

Bonn, Roentgen Institute of the University.

Erlangen, Gynecological University Clinic.

Freiburg, i. Br., Radiological Institute.

Goettingen, Institute for Medical Physics.

Stuttgart, Roentgen Institute of the Technische Hochschule.

Another measuring institute will be installed in Hamburg, Roentgen Institute of St. George Hospital.

It is urged that measurements or re-measurements be performed only by institutions, which are authorized by the Standardization Committee of the German Roentgen Society.

2. The measurings can be done through these institutions in two ways:

(*a*) The instrument to be tested is sent to the institute and there connected to the unit R, presuming that the instrument does not suffer any changes by the transportation.

(*b*) The testing is done by an officer of the institute at the place where the instrument is to be used. For this purpose the institute has prepared portable instruments which are kept in accordance with the normal unit by constant control and direct comparisons. The local transferring of the dose can be carried out accurately since it is possible to secure the continuance of the sensitivity even in portable instruments. To prove the temporary continuance of the sensitivity the radiation of radium can be efficiently used.

A measurement certificate is issued for testing an instrument. It contains; (*a*) date of test made; (*b*) type and number of instrument and short description of it; (*c*) qualities of rays, with which the measurement has been made; (*d*) measuring values given in R, or in R per second according to a dosimeter or a constant reading dosimeter.

4. For every standardization a fee of 50 marks and an additional fee for each radiation quality is to be paid. In out of town standardizations the fee is 100 marks, and also the travelling expenses. The fee is to be sent prepaid with the application to the respective institute.

5. The Standardization Committee cannot give any guaranty of the continuance of the standardized instrument in the state found when standardized. This has to be watched through preparations of radium or by other means. If there should occur deviations, a re-standardization is necessary.

A TRIBUTE TO DR. HOLMES

At the Twenty-sixth Annual Meeting of the American Roentgen Ray Society in Washington, the retiring president, Dr. George W. Holmes, was tendered a banquet by his present and former students and associates. He was presented with two bound volumes containing a photograph and the reprints of each man, one of which he has since presented to the Treadwell Library. Homage was paid to him as the dean of instructors in roentgenology, as it was he who first introduced the custom of training house-officers in his specialty. Since 1916, when this method of training young men was introduced, about twenty-five men have come under his guidance and have profited by his experience and his unusual ability in teaching. These men are now scattered throughout the United States and are carrying on the practice of roentgenology on the high plane and with the high ideals inculcated by their preceptor. Suitable ceremonies and expressions of appreciation were carried out at this banquet and telegrams and letters from the absent members of this large family were read.

Dr. Holmes, in response to this tribute, stated that he considered his best and most lasting work had been performed in training these young men to carry on his work.

Among those present or represented were the following: Dr. Philip Batchelder, Massachusetts General Hospital; Dr. David Beilin, Chicago; Dr. H. Kingsley Blake, St. Luke's Hospital, New York City; Dr. James F. Boyd, Providence; Dr. John D. Camp, Massachusetts General Hospital; Dr. John R. Carty, Massachusetts General Hospital; Dr. Carroll E. Cook, Oak Park, Ill.; Dr. David S. Dann, Kansas City, Mo.; Dr. Richard Dresser, Massachusetts General Hospital; Dr. Harry L. Farmer, Fort Worth, Texas; Dr. Roy G. Giles, Cleveland, Ohio; Dr.

Ross Golden, Presbyterian Hospital, New York City; Dr. Karl F. Kesmodel, Birmingham, Ala.; Dr. Charles F. Martin, Dallas, Texas; Dr. E. D. McCarty, Tacoma, Washington; Dr. A. S. MacMillan, Boston, Mass.; Dr. A. S. Merrill, Manchester, N. H.; Dr. Sherwood Moore, St. Louis, Mo.; Dr. R. T. Paine, Memphis, Tenn.; Dr. R. J. Reeves, Massachusetts General Hospital; Dr. Max Ritvo, Boston City Hospital; Dr. Howard E. Ruggles, Berkeley, Calif.; Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston; Dr. David Steele, Cleveland, Ohio; Dr. R. G. Vance, Boston, Mass.; Dr. S. L. Warren, Rochester, N. Y.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DAS THORAXRÖNTGENBILD IM FRÜHESTEN KINDESALTER. By Erich Saupe. Bound. Price, 10 Marks. Pp. 62, with 27 plates and 2 text figures. München: L. F. Lehmann, 1925.

The roentgen examination of the thorax in early childhood belongs to the most difficult of technical and diagnostic problems. This work, which fills out a lacuna in the literature up to the present, is the result of a comparative pathologic-anatomic and roentgenologic study of more than 100 bodies of infants. It advances us considerably in the knowledge of the particular pathological changes that are made evident roentgenologically, and the extent to which they may be differentiated. The differential diagnosis between tuberculosis and bronchopneumonia, which unfortunately is very frequently practically impossible, is thoroughly discussed; a caution is uttered against confusing hilus glands with bronchopneumonic foci in the vicinity of a hilus. An important disease of infancy and young childhood observed in about 10 per cent of the subjects examined is bronchiectasis, and this is thoroughly discussed.

Among the illustrations are to be found several beautiful pictures of hyperplasia of the thymus, and the text includes our present knowledge regarding the morphology and topography of this gland. A description is given of a rather rare finding of emphysema of the thymus occurring in conjunction with mediastinal and interstitial pulmonary emphysema and pneumothorax.

The frequent occurrence of interlobar fibrosis —in 18 per cent of the cases—demands that interlobar processes be suspected more than has hitherto been the case, making use of frontal transillumination and roentgenograms. The alterations occurring in the bony thorax of infants and young children such as osteogenesis imperfecta, rickets, and caries of the ribs, as well as the sources of error which might be responsible for an erroneous diagnosis are also discussed and explained with illustrations. A discussion of the diseases of the heart and vessels is also not neglected in this comprehensive work, and although roentgenograms upon corpses would appear to be but little adapted for such studies, a description is given of a case of transposed aorta.

The mechanical details of the book are good, as is the case in all of the Lehmann's hand atlases, and the twenty-five plates are satisfactory and instructive. Since few roentgenologists have had available the study of such a large number of infants, this work should easily find entry in every library.

F. HAENISCH.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

BABONNEIX, L., LEVY, MAURICE, AND POLLET, L. Encysted purulent pleurisy shown in the roentgenogram as a circular shadow. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 479–482.

Hydatid cysts in the lungs are shown as round opaque bodies in the roentgenogram which have been considered almost unmistakable. In the present paper, it is shown that to interpret such an observation as always that of hydatid cyst is an error and that encysted pleurisy will give an image very much like that of hydatid cysts. Such a case is reported in detail. The patient did not live near dogs, there was no urticaria, no eosinophiles in the blood, and the circular image was atypical of hydatid cyst. The sputum examination showed that there probably was encysted pleurisy with communication with the bronchioles. Operation later proved this to be true. The authors give a warning in this connection that care must be exercised in the interpretation of circular images in the lung cavity because of the possibility of confusion between hydatid cysts and encysted pleurisy.

BECCHINI, GASTONE. Relation between acidity and emptying time of the stomach. *Radiol. med.*, June, 1925, xii, 398–408.

The author studied the emptying time of the stomach in cases in which roentgen examinations were made with a view to determining the effect of giving a meal with or immediately after the barium and of giving it a considerable time after the administration of the barium. He found that when barium alone was given without any meal the emptying time of the stomach depended on the degree of acidity of the stomach contents and that hypoacid stomachs emptied quicker than hyperacid ones. Any meal given after the barium retards the emptying of the stomach. In comparing the effect of giving a meal immediately after the barium and an hour after he also found that the results were dependent on acidity. In hyperacid stomachs the meal given an hour after the barium retards the emptying of the stomach in comparison with the giving of the meal with or immediately after the barium, while in hypoacid stomachs the reverse is the case, and the emptying time is shorter when the meal is given after an hour than when it is given immediately.

The author thinks it will be possible to utilize these findings in determining the acid values of the stomach by roentgenoscopic examination.

BLANC, H. Two cases of cysts in the kidneys. *J. d'urol. méd. et chir., Par.*, 1925, xix, 5–12.

The cases reported here are rare, but not exceptional. In one case the pyelogram showed bilateral dilatation of the pelvis and the presence of cysts. In the second case, the pyelogram showed a single cyst in the kidney. Although there is little of interest from the roentgenologist's viewpoint, the cases are of significance in that the diagnosis was confirmed in this way.

CASTRONOVO, ETTORE. Idiopathic dilatation of the esophagus associated with stenosis of the pylorus. *Radiol. med.*, June, 1925, xii, 356–363.

The author describes a case in a man, aged fifty-four, in which a cicatricial stenosis of the pylorus was associated with an enormous dilatation of the esophagus. The symptoms presented by the patient showed that the paralysis and dilatation of the esophagus were primary, from some unknown cause, and were not secondary to spasm of the cardia or sphincter of the esophagus. Spasm may be associated with such a clinical picture but it is only coincidence. He had had symptoms of the dilatation of the esophagus for thirty years and had become accustomed to them so that they disturbed him very little and it was only recently that the development of signs of stenosis of the pylorus had compelled him to come for medical examination.

COSTANTINI, DOMENICO. An unusual malleolar fracture. Meissner's isolated fracture of the posterior margin. *Radiol. med.*, July, 1925, xii, 481–483.

Textbooks of anatomy in describing the lower end of the tibia do not give any special attention to what Destot calls the posterior process, because it is not distinguished by any special configuration or architectural peculiarities, but many considerations in regard to equilibrium of the body and the pathological anatomy of malleolar fractures justify giving it this special name. It includes about the posterior third of the tibial articulation. It

runs down a little lower than the rest so as to form a border on which the posterior part of the body of the astragalus glides. On its posterior-external lip there is a slight groove for the tendon of the flexor hallucis. It is very unusual for this process to be fractured alone without fracture of the malleoli. The author describes a case in a chauffeur who reported that it occurred while he was starting an automobile and pushing down strongly with his foot. It results in luxation backward of the foot and interference with dorsal flexion so that the foot remains in an equinus position. In traumatism of the ankle region a roentgen examination should always be made for fracture of this process as it occurs in about one case in ten of fracture of the malleoli although it is extremely rare alone.

COYON, AM., MARTY, P. AND AIME, P. Left bronchial dilatation in a young girl of fifteen years. Verification by tracheal injection of lipiodol. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 385–389.

This is but another case in which the use of lipiodol and the roentgenogram made possible positive diagnosis of bronchial dilatation. Six illustrations are given which show clearly the dilatations in the bronchioles, confirming positively the clinical diagnosis.

DEL BUONO, PIETRO. Contribution to the etiopathogenesis of enterospasm. Unusual clinico-roentgenological case of stenotic syphilid of the small intestine. *Radiol. med.*, July, 1925, xii, 451–560.

A woman of forty-one presented a mass in the abdomen which was diagnosed as tumor and operation advised. Roentgen examination showed spastic stenosis of a part of the ileum. The patient had had malaria for years and reported that the symptoms caused by the tumor were always worse during the attacks of malarial fever. As she had a positive history of syphilis the author concluded that it was a specific stenosis of the small intestine and that the attacks of fever produced spasm in the part of the intestine where the syphilitic infiltration was located. He advised treatment with arsenobenzol, on which the tumor and the signs of stenosis disappeared completely, though the patient still has attacks of malaria.

FIORI, EGIDIO. Unusual roentgen finding of an encysted metapneumothoracic pleurisy. *Radiol. med.*, July, 1925, xii, 434–440.

Fiori describes a case of encysted costal pleurisy in the form of a cylinder containing liquid which resulted from a serofibrinous pleurisy in the course of an artificial pneumothorax. It was in all probability formed by incarceration between solid membranes which formed like a diaphragm between the free pleural cavity and the wall of the thorax. This very rare case, which is accompanied by a roentgenogram of a similar case furnished by Prof. Redaelli clearly shows the necessity of following up the development of a pleurisy by roentgen examination, as physical examination alone does not always suffice to show its nature and form.

LAMARQUE AND ROUME. The obstetrical utilization of the roentgenogram; the presentation of roentgenograms of the fetus and pelvis. *Bull. Soc. d'obst. et gynéc. de Par.*, 1925, xiv, 88–94.

This is a general discussion of the possibilities of the use of the roentgenogram in obstetrical practice. It is not of much aid in the earlier period of pregnancy, but toward the end of the period, and especially near to the time for presentation, it gives much valuable information which aids the obstetrician. The position of the fetus, etc. is more easily determined in this way. Before exact information can be obtained relative to the size of the fetus with relation to the measurements of the pelvis, more exact methods of roentgenography will have to be worked out. At the present time the images are not clear enough to give all the information desired. The method of the intersection of the conical projections offers the most promising procedure. With such improvements at hand, this means of aiding the obstetrician will add greatly to the use he will make of it in the future.

LEDOUX-LEBARD, R. The roentgenologic examination of the gall-bladder by the method of Graham and Cole. *Paris méd.*, 1925, No. 20, 450–453.

The simple roentgenogram does not show images of the normal gall-bladder. The method devised by Graham and Cole makes this possible, and aids greatly in the study also of diseased conditions of this organ. The author has modified this method to the extent of using tetrabromphenolphthalein instead of tetrachlorphenolphthalein with equally good results and without the toxicity factor. Results with this method are reviewed, showing its value and usefulness for the study of the gall-bladder.

LÉRI, ANDRÉ, AND LINOSSIER, ALICE. Pseudocyst on the skull. (Bone disease of Recklinghausen localized in the skull? Hereditary syphilis?) *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 504–508.

By means of the roentgenogram, it was possible to determine the consistency of the

formation situated just under the left orbit. It was shown to be composed of spongy bone tissue; the outline of the cyst-like formation was smooth and clearly defined; the vacuoles were irregularly disseminated over the arch of the skull. Examination of the blood showed normal counts of white cells; skin reaction with hydatid liquid was negative, as was complement deviation with hydatid antigen, after the method of Weinberg. It is assumed that the condition was caused by hereditary syphilis. On the other hand, it may be the bone disease of Recklinghausen localized in the skull. The roentgenogram was of value in determining the structure of the nodule. The positive Wassermann reaction led to the belief that syphilis was the causative agent, in the absence of positive evidence of other cause.

LORIN, HENRI. Dislocations of the knee, hip and tibiotarsal joints. *Paris méd.*, 1925, No. 9, 202–208.

The value of the simple roentgenogram in studying dislocations of the knee, hip and tibiotarsal joints is emphasized and illustrations are given. Illustrations are also given to show these joints after dislocations are remedied. The presence or absence of fractures in such cases is easily determined at the same time.

MARTIN. Observations of calculus of the bladder not discernible in the roentgenogram. *J. d'urol. méd. et chir., Par.*, 1925, xix, 234–235.

It is commonly expedient to confirm the diagnosis of calculus of the bladder by a roentgenogram. In the present instance, although the clinical symptoms and operative findings showed the presence of such calculi, the roentgenogram was negative. At operation, forty-eight small calculi were found. After operation, the patient was able to urinate normally, in spite of an enlarged prostate. The only explanation given for the apparent invisibility of the calculi is the phenomenon of refraction, but even this seems an unreasonable assumption, for the calculi were readily noted on roentgenograms made of the calculi after their removal.

OUDARD AND SOLCARD. Pott's disease shown by lipiodol injection. *Bull et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 704–705.

A case is reported in which the exact position of the infection with the tubercle bacillus (in Pott's disease) was easily determined by the use of lipiodol and the roentgenogram. Clinical examination, location of the pain, etc., indicated that the abscess was in the iliac region, but after roentgen examination with lipiodol, it was found to be osteitis of the fourth lumbar vertebra. The region of the iliac crest was painful to the touch, but the symptoms were characteristic of Pott's disease, and the tubercle bacillus was found in material obtained from the abscess. The roentgenogram showed osteitis in the region of the fourth lumbar vertebra, the clear picture leaving no doubt as to the correct diagnosis.

PINCHERLE, PINO. Radiological study of mediastinal pleurisy. *Radiol. med.*, May, 1925, xii, 277–300.

Mediastinal pleurisy is the least frequent of diseases of the pleura which accounts for the few cases published in the international literature. Nevertheless it is not so rare as would be supposed from the rarity of the reports on it. Pincherle has collected 30 cases in the course of two years among about 2000 cases examined roentgenologically for various diseases. The roentgen characteristics of the disease are described and illustrated by means of roentgenograms, especial attention being given to the form localized on an internal horizontal plane, because this form can generally not be diagnosed by clinical methods. All of the cases were controlled by clinical examination and 2, in which the patients died, by autopsy.

His conclusions are as follows: The diagnosis of mediastinal pleurisy is essentially roentgenological and can be made by accurate observation and exact interpretation of all the characteristics of the shadow, such as appearance, density, localization, extension, the margins and their behavior during respiration. The effusions may be anterior, posterior or in a median plane, above or below the hilus, paravertebral, unilateral or bilateral. There may be several sacs on one or both sides of the median shadow, in the same plane or at different levels. The mediastinal effusion does not pulsate either spontaneously or from transmitted movements, and its shadow may be superimposed on one or even both the margins of the heart, giving rise to a double contour of the shadow of the heart. By placing the patient in an oblique lateral position the two shadows may be separated.

The clinical signs of mediastinal pleurisy are not characteristic. Serous pleurisy can be differentiated from dry pleurisy only by exploratory puncture, and empyema from serous effusion by the greater severity of the disease and the nature of the fluid obtained. It is hard to localize mediastinal pleurisy by percussion and it is only possible in cases located near the anterior or posterior wall of the thorax. Symptoms of compression are not

very frequent. Differential diagnosis must be made from tuberculous glands, pericarditis, abscess, tumors of the mediastinum in general and tumors of the thymus, especially in infants, aneurysm of the aorta and diverticulum of the esophagus.

The etiology is always tuberculous in the serous and dry forms, while the purulent forms may be due to other bacteria. The prognosis is good if there are no complications. Cure may be brought about by spontaneous absorption or surgical operation or by organization of the exudate and encapsulation. Only slight residues are left in the form of more or less extensive adhesions visible roentgenologically.

POSSATI, ALBERTO. A case of diaphragmatic hernia. *Radiol. med.*, July, 1925, xii, 440–451.

The patient was a woman, aged forty-eight. The left diaphragmatic hernia was produced by a rather unusual mechanism; the traumatism was indirect, that is the hernia was caused by contre-coup of the abdominal viscera while the stomach was full against the cupola of the diaphragm when the patient fell from a height of 6 or 7 meters and alighted in a sitting position with the trunk upright.

Roentgenoscopic and roentgenological examinations made before and after a barium meal showed that the splenic flexure of the colon had risen high up in the thoracic cavity, to only a few finger breadths below the clavicle, that the stomach had taken on a horseshoe form, open downward and that the curved line, convex upward, which separated the thorax from the abdomen was not single but double, the upper and external part being formed by the wall of the colon, the lower and internal part by the wall of the stomach. At first no paradoxical movement of the diaphragm was seen but on later examinations there was a partial paradoxical movement due to the movement of the intrathoracic loops of the splenic flexure of the colon. This movement was simultaneous with a pendulum movement of the ectopic cecum, together with the appendix and the last loop of the ileum, which was carried toward the median line above the crest of the right ilium, and of the ascending and transverse colon which were in a straight line and formed a diagonal passing across the abdominal cavity. The descending colon and sigmoid passed in a straight line to the rectum. The author thinks the horseshoe stomach was only an exaggerated form of cascade stomach. He studied the course of peristalsis which took place normally beginning at the cardia and progressing toward the pylorus although in the new position of the stomach the cardia was the lowest part.

ROGER, HENRI. Subarachnoid and epidural lipiodol experiments with roentgenograms after the technique of Sicard. *Paris. méd.*, 1925, No. 4, 81–90.

This is a study of the diagnosis of lesions of the vertebral column, meninges and medulla by epidural and subarachnoid lipiodol injections. As a result of lipiodol injections, the author noticed local temporary pain in the region of the lesions and increased temperature of 1° to 1.5°C. In roentgenograms after lipiodol injections the vertical position is found most advantageous, as is generally the case. Illustrations of roentgenograms are given (drawings) showing the usual picture of blockage of the oil at the site of the pathologic lesion, this being indicated by the opaque images in the relatively lightly-shaded bony structure. Accidental arrest of the oil is noted and illustrations showing cases given. It is, however, easy to distinguish between accidental and true arrest of the oil. The following conditions are noted; intradural tumor, pachymeningitis, arachnitis, syphilitic pachymeningitis, cancerous pachymeningitis, and Pott's disease.

ROGER, HENRI. The subarachnoid and epidural lipiodol test of Sicard in the diagnosis of lesions of the vertebral column, meninges and medulla. *Paris méd.*, 1925, No. 7, 145–150.

At the present time this technique is used primarily in the diagnosis of intraspinal tumors susceptible of surgical operation. It is not, however, used alone, but in conjunction with clinical and neurologic diagnoses. The lipiodol test of Sicard is of much value in diagnosis of lesions of the vertebral column, the meninges and the medulla, especially in determining the location of intraspinal tumors. The arrest of lipiodol does not, however, always signify intraspinal tumors or medullary compression. The neurologists findings must be first studied before placing dependence upon lipiodol and roentgenologic findings.

SERGENT, EMILE, AND COTTENOT, PAUL. Difficulties and errors of interpretation in the roentgen diagnosis of affection of the respiratory tract by intratracheal injections of lipiodol. *Presse méd., Par.*, 1925, No. 31, 500–502.

The use of lipiodol in the diagnosis of affections of the respiratory tract is open to certain difficulties, chiefly due to the use of too much or too little oil to bring out clearly and unmistakably the abnormal conditions present. In many cases, such abnormal features are not apparent in the roentgenogram because not

enough lipiodol has been used to completely fill the spaces present, and then again when too much is used the picture obtained is so indistinct that accurate interpretation is impossible. A clear positive image is usually of diagnostic value, whereas a negative image is of but relative value and must be interpreted with reservations. Many very good illustrations are given to demonstrate the points emphasized. Various conditions are discussed from the standpoint of their interpretation from roentgenograms.

SESSA, PIERO. Sesamoid anomaly of the foot or supernumerary tarsal bones? *Radiol. med.*, July, 1925, xii, 467–470.

A woman of thirty-two was examined for pain and swelling of the tibio-tarsal region which had existed for about six weeks. Examination from the side showed pes cavus and in the arch of the foot, just in front of the anterior process of the calcaneus, four small oval shadows with their long axes in the anteroposterior direction and enclosing between them a small quadrilateral space. The lack of severe pain or history of trauma or any inflammatory condition excludes the possibility of calcification of the soft parts. It remains to make a differential diagnosis betweeen supernumerary tarsal bones and sesamoid bones of the flexor tendons of the sole of the foot. From the position of the shadows the author concludes that they were not supernumerary bones, but as there are no reports in anatomical or roentgen literature of sesamoid bones of these tendons he would like to see further cases published.

SICARD, J.-A., AND CHAUVEAU. Generalized geodic osteitis (Recklinghausen type). Intramedullary injection of lipiodol. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 378–381.

Lipiodol and the roentgenogram were used in determining the extent of osteitis in the medullary canal of the lower limbs of a patient suffering from "osteitis geodic." The illustration included shows very clearly the exact position, dimensions, etc. of the condition. Injections were made in two places, the upper and the lower portions of the bones of the lower limbs. These bones were very spongy, and at autopsy were found to be quite friable.

SICARD AND FORESTIER. Radio-lipiodol in migrating cold abscesses. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 345–346.

Lipiodol and the roentgenogram were used in determining the location, size, shape, etc., of abscesses in the vertebral column. Clinical observations were not sufficient to make a diagnosis, but pain in walking and when attaining certain positions was sufficient to indicate some abnormal condition in the dorsal vertebrae. Ten cubic centimeters of lipiodol were injected into the spinal column and roentgenograms taken in vertical and horizontal positions, then in the Trendelenburg position. The form, dimensions, etc. of the abscess were very clearly shown.

SICARD, J. A., AND LAPLANE, L. Diagnosis of tumors of the vertebral column; pseudo-Pott's disease; radio-lipiodol. *Presse méd., Par.*, 1925, No. 3, 33–37.

A condition resembling Pott's disease, but which affects a different part of the vertebral column and differs in certain other respects, is described. It is difficult and uncertain to depend upon clinical evidence in determining which disease the condition really represents. The authors, after experience with 26 cases of vertebral neoformations, have adopted the following examinations as necessary to diagnose this "pseudo-Pott's disease:" examination of the spinal fluid; roentgenogram of the vertebral column; and, most important and most significant, the subarachnoid injections of lipiodol and subsequent roentgenograms. The localization of a neoplasm in any segment of the vertebral column does not carry with it any change in the spinal fluid of the lumbar region. On the contrary, neoplasms which develop in the superior dorsal region cause a hyperalbuminosis contrasted with lowered lymphocyte count. There is also a slight xanthochromia with massive coagulation. The roentgenogram of the spinal column is indispensable, for in this way a thorough study of the segments can be made from both the side and from the front or back. The subarachnoid injections of lipiodol and subsequent roentgenograms are still more important. Such injections may be made in the suboccipital region. This is not painful nor dangerous. Roentgenograms are taken in both the vertical and reclining positions. Care must be taken to distinguish between "false arrests" and arrest of the oil from true pathological conditions. It is preferable also to use lipiodol contained in aluminum rather than glass flasks, in order to retain its characteristic amber color. Medullary compressions are easily diagnosed, and also compression due to tuberculosis of the vertebrae.

A case of pseudo-Pott's disease is given in detail. The spinal tumor is shown in one of the inferior dorsal segments; the lipiodol showed very clearly the exact position and outline of the neoplasm.

SICARD AND PARAF. Ascending epiduritis due to a staphylococcus; radio-lipiodol; laminectomy; cure. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 50–52.

A man twenty-four years old suffered from an abscess in the epidura. A roentgenogram of the vertebral column did not show any abnormal condition. Lumbar puncture between the fourth and fifth lumbar vertebrae showed the presence of considerable pus caused by a staphylococcus. Laminectomy was decided upon, but before operation, in spite of the certainty of the location of the abscess, 1 c.c. of lipiodol was injected. The lipiodol was stopped at the tenth dorsal, in spite of the fact that the abscess was found in the fifth lumbar segment. However, laminectomy was practiced on the fourth and fifth lumbar vertebrae; a series of small abscesses were also found down to the tenth dorsal vertebrae, as was to be expected. This would not have been suspected had not the roentgenogram with lipiodol been made. The patient recovered from the operation without incident and the cure was complete. This case is remarkable in that only the epidural regions were involved in the infection, and not the dura mater, and also in that by means of the roentgenogram and lipiodol the smaller sources of infection were found in the lower vertebrae.

TUFFIER AND NEMOURS-AUGUSTE. On the visibility of the gall-bladder to the roentgen ray. *Presse méd., Par.*, 1925, No. 22, 348–350.

The diagnosis of lesions "sub-hepatic" is often very difficult and the surgeon is beginning to rely more and more upon the roentgenogram for determining the exact conditions in this region. This is especially useful in observing biliary calculi, and work has been reported in which the roentgenographic findings have been corroborated by results of operation. The diagnosis of cholecystitis by the roentgenogram was found to be correct in 45.5 per cent of the cases. The normal gall-bladder is larger than the diseased bladder in many cases, which condition is readily determined by the roentgenogram. However, the direct examination of the gall-bladder is not sufficient in many cases, in which case the functional test is used. The technique of using the salt tetrabromphenolphthalein for making roentgenograms of the gall-bladder is given. This is dissolved in distilled water, 5 to 5.5 gm. in 35 to 40 c.c. distilled water for patients under 55 kilos. The solution is sterilized in the water bath or the autoclave. This is injected in two portions at one-half hour intervals, slowly into the cephalic vein, 2 c.c. per minute. It is well to inject previously 0.5 c.c. of 1–1000 adrenalin. A few minutes after injection there is usually nausea, and sometimes vomiting. The roentgenograms are made at intervals of five hours with the patient in a reclining position, both from dorsal and ventral positions. Illustrations are given in which the results are shown in a number of cases of abnormal conditions. No serious effects were noted from injections made in the patients reported.

URECHIA, C. I., AND BODEA, I. Osteomalacia in a girl seventeen years of age. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 511–513.

Osteomalacia became evident in the patient at the age of ten, and by the time she was seventeen years old she was confined to her bed. The diagnosis was clear after roentgenologic examination. The bones of the pelvis were decalcified; the contour of the superior bones of the pelvis was deformed and presented a triangular aspect. The upper extremities of the femur were also decalcified; the ribs presented the same roentgenologic aspect; the bones of the skull were also decalcified, as well as the bones of the arms and legs. Basal metabolism was normal. Treatment with pituitrin, adrenalin, thyroidin, parathyroid extract, and extract of thymus was without any effect. Ovarian operation caused menstruation, but did not ameliorate the painful condition. However, treatment with phosphorus was effective in stopping the pain and thereby allowing use of the limbs. The diagnosis in this case depended upon the roentgenogram, for the clinical symptoms were not convincing.

UTILI, VOLTURNO. Two cases of spasm of the esophagus. *Radiol. med.*, July, 1925, xii, 424.

Two cases of spasm of the esophagus are described, one in a woman of sixty-five and the other in a woman of fifty. The first was a case of acute spasm of the upper part of the esophagus and was found on roentgen examination to be caused by a calcified gland at the level of the bifurcation of the trachea. The other was a case of chronic spasm near the cardia and was probably due to inflammation of a crural hernia.

WEIL, MATHIEU-PIERRE, AND DETRE, GEORGES. May gout be diagnosed by means of the roentgenogram? *Presse méd., Par.*, 1925, No. 22, 351–353.

In articular chronic gout, when uratic precipitations have infiltrated into the extremities of the bones and the articulations, the roentgenogram is capable of showing lesions of diagnostic importance. It is not, on the other hand, of much value in cases of acute gout. Many

illustrations of roentgenograms are given which show the deposits at the ends of bones of the feet and hands of patients suffering from chronic articular gout. Vacuoles are also evident in the bones of such cases. In many instances, only the roentgenogram will show the alterations of the bones due to gout, enabling a positive diagnosis to be made and proper treatment to be quickly started. Vacuolization of the bones of the fingers and toes is of much importance in this connection, and is discernible only with the roentgenogram.

ROENTGEN AND RADIUM THERAPY

BERARD, LEON. Neither roentgenotherapy nor curietherapy (are of value) in benign goiter. *Presse méd., Par.*, 1925, No. 33, 537–538.

The author is emphatic in his denunciation of both roentgenotherapy and curietherapy in the treatment of benign goiter. Not only are they useless in this connection, but actual harm is done in that at operation, which usually follows such treatment, the tissues have been so altered by the effect of the roentgen ray or radium that proper healing is hindered. Not only is this true, but there is an apparent tendency to stimulate metastasis. Following continued treatment with these radioactive substances, congestion of the blood vessels surrounding the goiter, with trophic modifications and adhesions in the vessels in the tissue of the thyroid, almost always results. A case in point is given in which there was definite metastasis and the other changes noted above. Not only is there a loss of time in such treatments, but the harm done by the effect on the tissues is sufficient to eliminate this form of treatment altogether in cases of benign goiter.

BORDIER, H. Medullary roentgenotherapy in infantile paralysis. *Paris méd.*, 1925, No. 17, 378–380.

The treatment of infantile paralysis has been attended by very favorable results in the hands of certain roentgenologists. Others, however, have had inconstant results and have placed little confidence in the treatment. The author explains this by noting that most physicians consider the sacro-lumbar region as the proper place for using the roentgen ray in this treatment. As a matter of fact, the rays must be concentrated in the region between the eleventh dorsal vetebra and the first lumbar vertebra for paralysis of the inferior members, and between the third and sixth cervical vertebrae when the paralysis is in the superior members. The irradiations must be deep enough to reach the cells in the medulla and they must be concentrated to a point, or at least in a small area. The author then gives in detail his method for determining doses according to angle of rays to the skin and the number of units used in treatments as measured by an ionometer.

EMILE-WEIL, P., AND LACASSANGE. Apropos the communication of Brule and Roulin. A case of aplastic pernicious anemia caused by radium. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 535–536.

This is but another instance of pernicious anemia caused by overdosage of radioactive substances. This patient had been under treatment with radium since 1920. In July, 1924, symptoms of progressive anemia were manifest, the patient dying in January, 1925, without any apparent relief. The onset was marked by digestive disorders, extreme anemia, slight hemorrhage; death followed in spite of three blood transfusions and other aids. This condition is now recognized as a distinct disease which may follow overdosage or too prolonged treatment with radium, thorium and the roentgen ray. The authors indicate that it is highly desirable that some legislation be passed forbidding such excessive use of these substances so as prevent such conditions.

GOUVERNEUR, R., AND FABRE, S. The cystoscope in cancer of the cervix of the uterus before and after curietherapy. *Gynéc. & obst., Par.*, 1925, xi, 189–198.

A cystoscopic study of 200 cases of cancer of the cervix of the uterus before and after curietherapy is reported. The cystoscope is considered to be of great value in the study of the effect of radium and also as a means of determining whether or not radium treatment is indicated. The nature of the lesions and the degree of adhesions can be readily determined in this way. Most of the lesions in this series were inflammatory. In cases of infiltrating ulcerations of the nature of neoplasms, active treatment with radium would be useless and even dangerous. In cases of small ulcerations with vesicular edema, application of rather strong doses of radium would be indicated. Palliative doses often have a very favorable effect on certain functional signs. Colored illustrations are given to show the effect of radium in cases of edema treated. The illustrations before and after treatment are very convincing of the favorable effect of radium in these cases.

GROMADZKI, HENRI. The treatment of fibromyomas of the uterus. *Gynécol. & obst., Par.*, 1925, xi, 33–37.

The author considers it difficult at this time to give any definite conclusions as to the

efficiency of the roentgen ray and other radioactive substances in the treatment of fibromyomas of the uterus. A great many cases in which there are no severe symptoms and which disappear after the menopause, do not require any treatment whatever. Where the symptoms are only menstrual, treatment with the roentgen ray or radium is indicated. Since both these agents in concentration sufficient to destroy young epithelial cells will at the same time increase the growth of connective tissue cells, they must be used with considerable caution. The therapeutic use of these agents in the treatment of fibromyomas may be only indirect. Both destroy the function of the ovaries and produce a premature menopause. The connective tissue cells of the uterus increase in thickness and cicatrization results. There is no doubt that the use of these agents has a beneficial effect in the treatment of such cases where menorrhagia and metrorrhagia are the main symptoms, but premature menopause must be expected.

KOGAN. Hypertrophy of the prostate and radium. *J. d'urol. méd. et chir., Par.*, 1925, xix, 23–28.

Six cases of hypertrophy of the prostate were treated with radium with varying degrees of success. Three recovered entirely following the radium treatments, one was greatly relieved and the two others were incompletely ameliorated. In cases considered inoperable, treatment with radium brings about a condition in which operation can be successful. Radium is applied by way of the urethra and the rectum, in most cases 55 mg. of radium being applied for twenty-four hours in the urethra and twelve hours in the rectum. The conditions treated were of fairly long standing, retention of urine accompanying the prostatic hypertrophy, necessitating artificial removal. The results from the use of radium are sufficiently encouraging to warrant its use in all supposedly inoperable cases, and in less severe conditions of hypertrophy of the prostate.

LACASSAGNE, ANT. Review of the present state of internal therapeutic practice with radioactive bodies. *Paris méd.*, 1925, No. 6, 133–137.

This is a summary and review of the present status of the use of radioactive substances in internal therapeusis. Among the conditions so treated, with radium especially, are cancer, leucemia, anemia, gout, articular rheumatism, and diseases of the nervous system. The field is limited; although many examples of amelioration of various conditions, and cures are known, there are also many cases in which results are variable. The above conditions may be considered as susceptible of amelioration or cure by means of this therapy.

LAFFONT. Vaginal hysterectomy after the application of radium. *Bull. Soc. d'obst. et de gynéc. de Par.*, 1925, xiv, 233–234.

Radium was used in the treatment of cancer of the isthmus of the uterus, three weeks after which hysterectomy was accomplished successfully, but with certain difficulties. The radium had caused scarring of the tissue in the cul-de-sac; the cervix was extremely friable, with hemorrhage and also difficult hemostasis. A certain anemia was also apparent, a slight edematous condition was noted and the process of healing was slow. The destructive effect of radium on the tissues of the uterus is held responsible for these complications.

LAIGNEL-LAVASTINE. Acute poliomyelitis with paraplegia and Babinski signs; Pettit serum, roentgenotherapy, thermopenetration and galvanotherapy; cure. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1925, 3. s., xli, 806–808.

Roentgenotherapy was one of the treatments applied in a case of acute poliomyelitis in which complete cure resulted. It is, of course, difficult to say to what extent the roentgenotherapy was responsible for the cure. The treatment consisted of 400 R each week on the dorso-lumbar region. The lumbar region received 6,000 R without any ill effects. Pettit's serum, diathermy and galvanotherapy were applied at about the same time, and the combination of treatments may be held responsible for the cure.

LAVEDAN, J. The cardio-vascular reactions provoked by the roentgen ray. *Paris méd.*, 1925, No. 6, 137–141.

In the experience of the writer, the ordinary doses of the roentgen ray as used in therapeutics have never given rise to any serious alterations of the blood. However, when strong doses are given over a long time on a broad surface of tissue, such changes as noted by certain observers may result. Increase of filters, increase of different surfaces irradiated seem to be the proper measures to take in preventing grave cardiac disturbances and serious changes in the blood.

MARTIN. Probable acceleration of the growth of cancer of the bladder caused by ultra-penetrating roentgenotherapy. *J. d'urol. méd. et chir., Par.*, 1925, xix, 232–234.

In the treatment of a small cancer of the bladder by deep roentgenotherapy, the increase in size and seriousness of symptoms was so rapid that the author considers the effect of

the roentgen ray as responsible. At first there was an improvement in the condition of the patient, but this was followed by severe symptoms which necessitated operation. In spite of the apparent removal of the cancerous tissue, so far as was possible, the patient died soon after. The increase in size of the cancer took place more rapidly than usual, indicating that the roentgen ray stimulated the growth of the cancerous tissue.

SCHICKELE. Fibroma treated by deep roentgenotherapy without success; operation later. *Bull. Soc. d'obst. et de gynéc. de Par.*, 1925, xiv, 112–114.

In 1919 a small fibroma of the uterus was observed in a young woman. By 1922 it had increased in volume to 20 × 22 cm. Operation was advised, but the patient objected and roentgenotherapy offered the only recourse. Two treatments were given of four hours each for four days; these were followed by prostration and continued vomiting. In June, 1924, the fibroma was larger than it was in 1922 in spite of the roentgenotherapy. After hysterectomy cure was complete. The importance of this observation lies in the fact that deep roentgenotherapy did not stop the increase in size of the uterine fibroma.

MICHON, MOULONGUET, AND BLAMOUTIER. Very grave metrorrhagia in a young girl; persistence of the symptoms for three years in spite of many treatments with radium; infectious uterine endovascular lesions. *Bull. Soc. d'obst. et de gynéc. de Par.*, 1925, xiv, 131–142.

The present case is interesting in that the metrorrhagia was extremely grave, endangering the life of the patient; in that three radium treatments were ineffective; and because of an infection with a streptococcus in the arteries and veins of the uterus. The immediate cause of the onset of these symptoms was a miscarriage, which offered conditions favorable to infection of the uterus. It is assumed that the effect of the radium added somewhat to the uterine vascularitis; certainly it did not alleviate the metrorrhagia. After hysterectomy the patient recovered.

SCADUTO, GIOACHINO. Roentgen or radium therapy of hypertrichosis? *Radiol. med.*, July, 1925, xii, 483–486.

In a former volume of Radiologia medica (Vol. ix, No. 2, 1922) the author described the good results he had obtained in the roentgen treatment of 100 cases of hypertrichosis extending over a decade. He now presents a very severe criticism of an article by Palumbo in the *Gior. Ital. delle malattie veneree e della pelle*, No. 2, 1924, in which that author advocates the radium treatment of hypertrichosis, finding it very much superior to roentgen treatment. Scaduto says that epidermatitis is almost inevitably brought about by treatment of this condition with hard rays, either roentgen or radium, and that the bad effects, such as headache and vomiting reported by Palumbo and attributed by him to defective function of endocrine glands were really caused by the prolonged use of hard rays. He holds that the good results obtained by himself and Lanzi effectually disprove the criticisms of the roentgen method made by Palumbo.

VALENTI, ALESSANDRO. Homogeneous irradiation of deep organs. *Radiol. med.*, July, 1925, xii, 425–431.

The author reviews the different methods used in roentgen therapy of deep organs and discusses their defects. It is necessary to study the region to be irradiated with great care and calculate the dose to be given accurately in order to get a uniform distribution of the radiation in the region to be treated without irradiating normal tissue needlessly, without causing lesions of internal organs and without running the danger of giving an insufficient or excessive dose in a part of the pathological focus. He concludes that the best method of accomplishing this is that of Holfelder, which is described in some detail.

MISCELLANEOUS

BIANCHI, GIOVANNI. The importance of congenital abnormalities of position in the pathology of the large intestine. *Radiol. med.*, June, 1925, xii, 325–347.

The author first reviews the mechanism of the embryonic development of the large intestine and then describes the different anomalies of position, which may be found in the adult as a result of defective development, giving their symptomatology, results of roentgenology with illustrative roentgenograms and their treatment. He then describes 4 very interesting cases which he observed and which were verified by operation. The first was characterized by great mobility of all the right colon and cecum; the latter could be moved from right iliac fossa to the epigastrium. The transverse colon, apparently elongated, was drawn and twisted by adhesions into the left hypochondrium. In the second case the cecum was high and mobile, in the third the right colon was short and mobile, in the fourth the splenic flexure was fixed in its typical site and the distal colon was excessively long and mobile. He classes all of the latter three cases

in a group which he calls "embryonic position of the large intestine," the cause of which is incomplete rotation. He calls attention to the relations which exist between congenital abnormalities of position and variations in the length of the segments of the large intestine. It may be that certain aspects of excessive length of the transverse colon are due to displacement of the right colon, while certain cases of dolichosigmoid may be due to defective rotation of the large intestine, without the total intestine being elongated. Nevertheless many cases of dolichocolon have a congenital origin and are caused by the fact that mobile portions of the colon combine with neighboring fixed portions which are congenitally mobile. Dolichosigmoid is frequently caused by the fact that the large intestine becomes prematurely fixed in the left hypochondrium and does not allow the distal colon to rise as it develops in length.

These congenital abnormalities of the large intestine are of great importance in pathology as they may cause serious occlusions and inflammatory conditions. Their diagnosis requires roentgen examination and treatment is necessarily operative.

Bonanno, Matteo. Cholesterin in ovarian roentgen castration. *Radiol. med.*, July, 1925, xii, 461–466.

The author discusses the importance of the cholesterin content of the blood in biology and pathology and expresses the opinion that a part is played in cholesterin metabolism not only by the liver and suprarenals, which are the organs most directly concerned in it, but also by the ovaries. It is hard to explain in any other way the hypercholesterinemia that is found in pregnancy and the climacteric and in women who have had the uterus and adnexa removed. For the purpose of settling this question he studied the cholesterin content of the blood in roentgen castration practiced for fibromyomas of the uterus. He found in 10 patients submitted to this examination that the cholesterin content after a series of 8 to 10 irradiations was higher than it had been before the irradiation. In some cases it was possible to demonstrate hypercholesterinemia even after some months. These experiments prove that the ovaries have an effect on the cholesterin content of the blood.

Bortini, Ennio. Application of the thermo-ionic valve to roentgenology. *Radiol. med.*, July, 1925, xii, 471–480.

The author gives a detailed review of the physical principles and method of functioning of the thermo-ionic valves which are used in radiotelegraphy and radiotelephony and of their derivation from electronic roentgen tubes and discusses their use for the purpose of suppressing the inverse wave in roentgen-ray apparatus as a result of their capacity for rectification, this characteristic having made it possible to obtain even currents with a high tension and constant intensity, for example by Siemens' stabilovolt, by means of suitable thermo-ionic valves. He then discusses the use of the audion as an amplifier of the intensity of roentgen rays, the value of which can be measured directly and continuously with the dosimeters of Siemens and Veifa. He also calls attention to the amplification and registration of heart sounds by means of the audion, which is quicker, if not more accurate, than that obtained by the electrocardiograph, and also to the production of diathermic currents, for which these lamps are very well adapted.

Brule, M., and Boulin, R. A case of aplastic pernicious anemia caused by radium. *Bull. et mém. Soc. méd. de hôp. de Par.*, 1925, 3. s., xli, 528–533.

Pernicious anemia caused by overdosages of the roentgen ray is not uncommon. However, such conditions resulting from the use of radium are rare. Usually, or in fact always, such cases result from careless handling of radium by physicians and others who handle radium. In the case reported here, the patient was such a person and came to her death from aplastic pernicious anemia because she was not careful enough in handling radium tubes and because she lived continually in near proximity to radium. She worked in a radium institute and was known to carry radium tubes without protection to her skin. The erythrocyte count was reduced to 960,000 before death, and during the course of the disease no means available could increase the count or stop the reduction. The other clinical symptoms of pernicious anemia accompanied the condition throughout. It is recognized that cases of pernicious anemia caused by radium are not patients who have been treated with radium, but are invariably persons who work with it without exercising proper care.

De-Bernardi, Renato. Roentgenological study of Madelung's deformity. *Radiol. med.*, June, 1925, xii, 392–398.

Two cases are described in detail of Madelung's deformity of the wrist joint. Both were in children less than ten years of age, while in the majority of cases the patients are between ten and twenty years of age. The roentgen picture is typical. In the dorso-palmar picture

the epiphysis and distal metaphysis of the radius are shorter and thicker than normal. In the center of the bone there is great rarefaction of the spongy tissue and abnormal trabeculation. The ulna is displaced laterally and upward and there is no disturbance of trabeculation in it. In the lateral projection the radius sometimes presents a large curvature, while sometimes the curvature is abrupt and affects only the metaphysis and the distal epiphysis. The cause of Madelung's disease lies solely in the epiphyseal line of the radius; the deviation of the ulna results only from the arrest of development of the radius.

After reviewing the different theories as to the cause of the disease the author concludes with Bertolotti and Olier that it is a metaepiphysitis of the growth period caused by localized rachitic dystrophy. In these cases the rachitic dystrophy remains localized in the metaphysis and distal epiphysis of the radius.

DE JONG. The action of beta and gamma rays on guinea pigs. *Gynécol. & Obst., Par.*, 1925, xi, 250–264.

Guinea pigs were placed in glass containers and exposed to the gamma and beta rays from radium for various lengths of time. The condition of the animals during the time of exposure was noted and histological examination of various organs made after the test period. The exposure produces definite reactions in the animals. In many cases it provokes a falling out of the hair; in other cases this does not result, so that no definite conclusions may be drawn in this respect. The color of the hair does not affect the results. When pregnant animals are subjected to the rays, although gestation resulted, some of the young died the following day, and later the mother and remaining young died also. Sterility of all the guinea pigs resulted from these exposures, the males and those females not pregnant. Death followed in many cases after removal from the rays. Lesions of the spleen were found in all animals after exposure to the rays for varying time periods; these lesions consisted principally of hypertrophy with pigmentation. At the same time, lesions of the ovaries were found in the females. There was diminution of follicles, and often presence of cysts. Examination of the blood often showed increase in eosinophiles.

EPIFANIO, GIUSEPPE. Introduction to a course in medical roentgenology. Colloidal chemistry and roentgen rays. *Radiol. med.*, June, 1925, xii, 376–387.

It seems that all the effects of roentgen rays, chemical and biological, are due to corpuscular irradiation. A bundle of roentgen rays cutting a body liberates electrons from the atoms of the body which are diffused throughout its substance; this is the so-called corpuscular irradiation. The greater the atomic weight of the elements that are found in a tissue, the greater the quantity of rays which will be absorbed, generating secondary rays. Human tissues are made up of materials with an atomic weight of from 1 to 55; therefore their absorption of rays and the intensity of the biological effect of the rays on them vary to the same extent. Moreover organ tissues, intracellular and pericellular fluids are for the most part made up of colloids, the ultramicroscopic unit of which is called micella, and the power of absorption of normal and pathological tissues depends on the size, constitution, surface tension and electrical charge of these ultimate particles. The constitution of the micella is closely related to the vitality of the cell. Growth of the cell is dependent on the active part of the micella, strongly ionized, the osmotic pressure of which must be considerable. On the contrary, senescence of a tissue is due to a decrease of the active part of the micella and a decrease of ionization, always causd by crystallization of the nucleus. The electrical charge and the ionization of the micella are the indispensable conditions which assure colloid dispersion. This explains the greater vulnerability of young cells. As the cells age the colloidal condition changes; in the young cell the colloid granules are amorphous, while in old age they approach a crystalline condition and there are changes in the size of the colloid granules and in the number of free ions which gravitate around them.

There are two fundamental problems in the biology of radiation: (1) Does the biological action depend on the quantity or quality of the rays? (2) In addition to a destructive action, is there a stimulating effect of the rays? The German authors were inclined to attribute the biological action to quantity, but the author believes it is due to the length of the wave, that is, the quality. Progress has been made by using harder and harder rays. In answer to the second question, he decides that the rays do not have a stimulant action, but that the apparent stimulation is due to destruction of certain sensitive cells which permits of increased growth of other less sensitive ones.

MARZI, PAOLO NATALE. A new type of stand for roentgenological research. *Radiol. med.*, June, 1925, xii, 388–391.

This combined table and stand for carrying a screen and tube is illustrated. Its advantages over the ones previously in use, according to

the author, are that the table is detachable from the tube-screen carrier and can be used at any time for any other purpose; that the tube and screen can be moved around the patient lying on the table in such a way that he can be examined in all projections, including that in lateral decubitus; that the table is a plane that can be inclined either lengthwise or sidewise; it permits of the rapid substitution of a photographic plate for the screen so that a roentgenogram can be taken during roentgenoscopy; it permits of the localization of a foreign body by a very simple method; it can be used for the taking of stereoscopic plates. In short, it includes everything necessary for a complete roentgen examination

NUVOLI, U. Condition of the heart and aorta in a case of Addison's disease. *Radiol. med.*, June, 1925, xii, 347–355.

A detailed description is given of a case of Addison's disease in a patient, aged forty-eight, who had a progressive pulmonary tuberculosis and probably also a tuberculosis localized in the suprarenal capsules. An orthodiagram showed the heart a little increased in size in all its diameters, but more especially on the left side, while the aorta was normal as long as the pressure was not less than 110 mm. mercury. When the pressure fell below this point there was an increase in the volume of the left ventricle and a considerable increase in the lumen of the aorta. On an intravenous injection of adrenalin sufficient to bring the pressure back to normal the left ventricle and aorta decreased in size and finally returned to normal. The author discusses the apparent contradiction between this and the clinical and post-mortem findings in Addison's disease but concludes that it is only apparent and that this dilatation is due to the loss of tonus caused by the deficiency of adrenalin. Percussion does not show any enlargement of the heart in Addison's disease, but it is well known that the orthodiagram shows much smaller increases than percussion, which does not show an increase of less than a centimeter. Autopsy findings show hypotrophy of the heart with flaccidity of the myocardium, but it is this very loss of tonus which causes the heart to dilate easily in this disease.

PODESTA, VITTORIO. Roentgenological study of the reaction of the gastrointestinal tract to an alkalinized opaque paste. *Radiol. med.*, June, 1925, xii, 363–376.

A few studies have been made of the effect of adding acid to the opaque medium used for roentgen examination but none before of the effect of alkalies. The author used carbonate and bicarbonate of sodium with ordinary barium paste. Sometimes the alkali was mixed with the paste, sometimes given before and sometimes after. The experiments were all performed on healthy subjects and details of 12 cases are given. There was no effect on gastric tonus nor on the form, size nor position of the stomach. But the alkali hastened the opening of the pylorus and the passage of the stomach contents into the duodenum and hastened stomach digestion. It also acted on the small intestine, hastening digestion in the jejunum, and even on the large intestine but to a less degree.